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SOBOTTA - McMURRICH
ATLAS OF HUMAN ANATOMY

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ATLAS OF
HUMAN ANATOMY

BY DR. JOHANNES SOBOTTA
PROFESSOR OF ANATOMY AND DIRECTOR OF THE ANATOMICAL INSTITUTE IN BONN

EDITED FROM THE SIXTH GERMAN EDITION BY

J. PLAYFAIR McMURRICH
PROFESSOR OF ANATOMY IN THE UNIVERSITY OF TORONTO

VOLUME I

THE BONES, LIGAMENTS, JOINTS, REGIONS AND MUSCLES
OF THE HUMAN BODY

VOLUME II

THE INTESTINES OF THE HUMAN BODY
INCLUSIVE OF THE HEART

VOLUME III

THE NERVOUS AND BLOOD VASCULAR SYSTEMS AND THE
SENSE ORGANS OF THE HUMAN BODY

G. E. STECHERT & CO., NEW YORK 1927

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VOLUME I

THE BONES, LIGAMENTS, JOINTS, REGIONS AND MUSCLES OF THE HUMAN BODY

*WITH 166 COLORED AND 143 UNCOLORED FIGURES,
TOGETHER WITH 29 PARTLY COLORED TEXT-FIGURES, FROM
ORIGINAL DRAWINGS BY K. HAJEK*

[illegible]

G. E. STECHERT & CO., NEW YORK 1927

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From the Preface to the first edition.

I have endeavoured in this work to produce an Atlas that will serve the practical needs of students of medicine and practicing physicians. It is not intended to be an Atlas for the use of experts in Anatomy. Consequently in the make up of the book a limitation to what was absolutely necessary seemed to me a prime consideration.

In its outward form this first volume of the work is treated throughout as an Atlas, is arranged primarily for use by classes in dissection and follows closely the usual methods employed in such classes. Any difficulty that might arise for the beginner by an unusual method of presentation of the figures has therefore been carefully avoided.

The illustrations are so arranged that there is to be found on the opposite page, in addition to the explanation of the figures, a brief descriptive text. This enables the student using the book during his dissection to review rapidly the chief points in his preparation. In the Myology the explanatory text takes the form of tables which give at a glance the origin, insertion, nerve supply and action of the muscles. As regards the methods of reproduction of the figures polychromatic lithography is used for the first time — so far as I am aware — in anatomical illustrations. Of the 34 colored plates 30 are reproduced by this process, the remaining 4 by the method of three (four)- color printing, again used for the first time in this connection. Nearly all the figures in the Myology are reproduced in this manner. For the other illustrations the so-called autotype process is used, and its suitability for the purpose may be seen from the Atlas itself. In addition key-figures, diagrams, etc. have been reproduced by line etching.

For greater convenience special colors have been extensively used in the illustrations reproduced by the autotype process, a chamois tint for the bones in illustrations of the articulations and many of the muscle figures, different colors for the individual skull bones in representations of the entire skull and in topographic figures of the skull bones. For the names of parts the Basel Nomenclature has been used.

The publishers have spared no pains in producing a book that certainly surpasses in excellence of reproduction all previous works, while at the same time it does not materially fall behind the most of them in the number of illustrations.

Würzburg, October 1903.

The Author.

Preface to the second edition.

The second edition of the first volume shows very important changes. In the first place the former lithographed plates of the Myology have been entirely omitted and replaced by polychromatic autotypes, as had already been done in the second and third volumes of the first edition. This was done partly for uniformity in reproduction, partly because the illustrations of the first volume were not pleasing to many readers on account of the colors being too bright and glaring on the white paper. I have especially decided to provide new illustrations of the muscles, since those of the first edition frequently did not give a sufficiently natural impression owing to the position of the cadaver. Instead of using photographs of the cadaver, those of an athletic man of small stature were taken as a foundation. These photographs were prepared by the illustrator Mr. K. Hajek and within outlines prepared from them the muscles were drawn from dissections. In this way one obtains correct and expressive figures which, furthermore, are more in keeping with the format of the book. The use of yellow, red and blue colors is naturally merely conventional, although they approximate the natural tints. At the same time the number of the illustrations for the Myology was considerably increased and, furthermore, for the trunk, and especially the thorax and abdomen three-quarter views were employed instead of complete profiles. Mr. K. Hajek has drawn the illustrations in a thoroughly satisfactory manner.

The portions of the book dealing with the Osteology and Syndesmology have also been expanded in various places.

Würzburg, July 1913.

The Author.

Preface to the sixth edition.

The sixth edition is an only slightly altered impression of the fifth. This edition of the I. Volume contains no remarkable alterations except a few small additions to the illustrations and a revision of the text.

Bonn, September 1926.

The Author.

Preface to the Second Englished Edition.

This first volume of the second Englished edition of Sobotta's Atlas of Descriptive Anatomy is translated and edited from the sixth German Edition. Compared with the first Englished Edition there are a number of differences, the chief one being that the text-book feature has disappeared, the book being more strictly an anatomical Atlas. The descriptions of the structures shown in the illustrations are greatly condensed and, as far as possible, are on the pages facing the illustrations under consideration. The labels on the figures are the B. N. A. terms in their original latin form; in the text, however, it has seemed advisable to translate them, for the most part, into their English equivalents or, in rare cases, to use a term more familiar to English-speaking students. Where misunderstandings might occur the B. N. A. term is also given.

The text, however, is relatively unimportant; the illustrations are the chief glory of the book and to give these English explanations and to render them available for English-speaking students of anatomy is the object of this edition.

The Editor.

Contents.

Osteology pp. 1—102, Figs. 1—173.
  A. Axial skeleton pp. 1—19, Figs. 1—38
  B. The skull and skull-bones pp. 20—65, Figs. 39—108.
  C. Appendicular skeleton pp. 66—99, Figs. 108—168.
  D. Structure of bone pp. 100—101, Figs. 169—173.

Syndesmology pp. 102—147, Figs. 174—234.
  A. Articulations and ligaments of the trunk and head pp. 102—113, Figs. 174—194.
  B. Articulations and ligaments of the Upper Extremity pp. 114—125, Figs. 195—208.
  C. Articulations and ligaments of the Lower Extremity pp. 126—147, Figs. 209—234.

Regions of the Body pp. 148—151, Figs. 235—238a.

Myology pp. 152—248, Figs. 239—326, Plates 1—4.
  A. Muscles of the Back pp. 152—163, Figs. 239—326, Plate 1.
  B. Muscles of the Thorax and Abdomen, including the Diaphragm and Iliopsoas pp. 164 bis 178, Figs. 248—257.
  C. Muscles of the Neck pp. 178—185, Figs. 258—263.
  D. Muscles of the Head pp. 186—197, Figs. 264—271.
  E. Muscles and Fasciae of the Upper Extremity pp. 197—221, Figs. 272—297, Plate 2.
  F. Muscles and Fasciae of the Lower Extremity pp. 222—248, Figs. 298—326, Plates 3—4.

Explanation

of the abbreviations used in the illustrations of this volume.

ant. = anterior
art. = artery
art. or artic = articulation
ext. = external
inf. or infer. = inferior
int. = internal
later. = lateral
lig. or ligam. = ligament
ligg. = ligaments
m. = muscle1)
mm. = muscles

medial = medial
n. = nerve, nn = nerves
oss. = bone
post. = posterior
proc. = process
prot. = protuberance
spin. = spine
sup. or super. = superior
sut. = suture
tuberc = tubercle
tuberos. = tuberosity

× after a name denotes that the part indicated has been cut away or cut through.
() denotes that the part is seen through another structure.
If a part is not named, as a rule it has already been named on the preceding figure.

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1) As a rule the m. is omitted before the names of muscles and these are distinguished from the names of vessels, nerves, etc. by the use of a capital initial letter.

Osteology.

A. Skeleton of the Trunk.

The skeleton of the trunk consists of the vertebral column together with the ribs and sternum.

The Vertebrae.

True and False Vertebrae may be distinguished. The former are represented by 7 cervical vertebrae, 12 thoracic and 5 lumbar, while the latter are the sacrum and coccyx.

The essential parts of a vertebra are the body *(corpus)*, the arch *(arcus)*, the transverse processes, the spinous process and the articular processes.

The **body (Corpus)** forms the principal part of the vertebra; it lies anteriorly and has a low cylindrical form. From it arises by means of the pedicles *(radices)* the arch *(arcus)*, between which and the posterior surface of the body is the vertebral foramen, usually transversely elliptical in form. Each pedicle *(radix)* presents an upper shallower and a lower deeper notch *(incisura vertebralis)*. When the vertebrae are articulated the notches of successive vertebrae form foramina *(foramina intervertebralia)* through which the spinal nerves pass. Those vertebrae with which ribs articulate present toward the posterior part of both the upper and lower border of the body on each side an articular surface *(fovea costalis superior and inferior)* for the head of the rib.

The **Transverse processes** are paired processes that project laterally from the anterior part of the arch or, in the case of the cervical vertebrae, from the pedicles. Their extremities, in the case of the thoracic vertebrae, present on their anterior surface an articular surface *(fovea costalis transversalis)* for the tubercle of the rib.

The unpaired, median **spinous process** arises from the posterior part of the arch and is directed backwards or backwards and downwards. The portion of the arch between the spinous and transverse process on each side is termed the *lamina*.

The paired **articular processes** serve for the Articulation of the vertebrae with one another. Each vertebra bears two superior and two inferior articular processes. They arise from the arch close behind the pedicles and bear articular surfaces, which lie in different planes in different vertebrae.

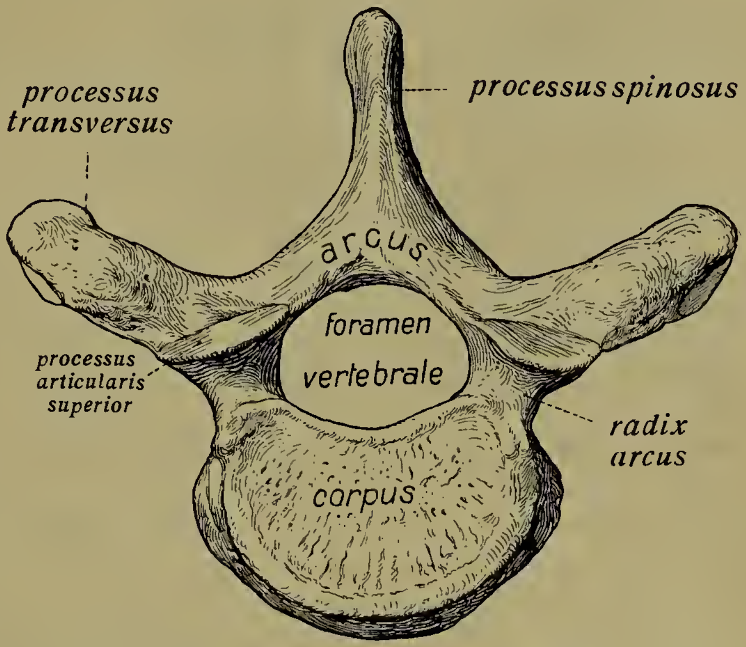

Fig. 1. Thoracic vertebra, seen from above.

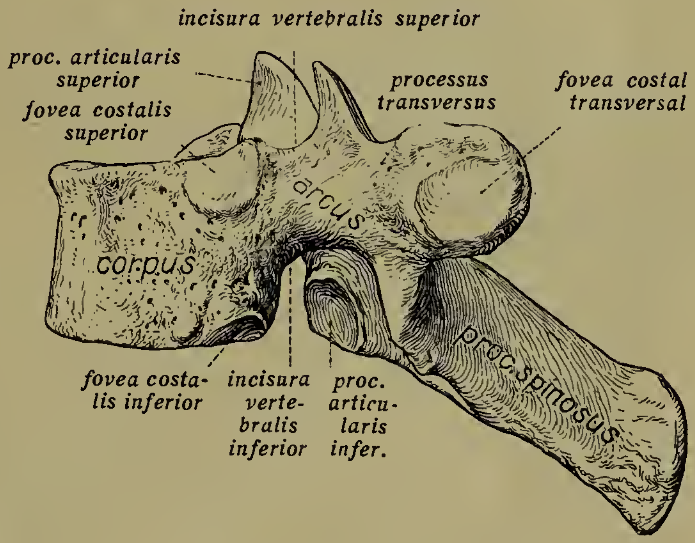

Fig. 2. Thoracic vertebra, seen from the side.

The Cervical Vertebrae.*)

Fig. 3. The cervical vertebrae seen from behind and from the right. ($^1/_1$)
Fig. 4. The fifth cervical vertebra seen from above. ($^1/_1$)
Fig. 5. The atlas seen from above. ($^1/_1$)
Fig. 6. The atlas seen from below ($^1/_1$) * = position of the superior articulating surface.
Fig. 7. The axis *(epistropheus)* seen from in front. ($^1/_1$)
Fig. 8. The axis *(epistropheus)* seen from behind. ($^1/_1$)

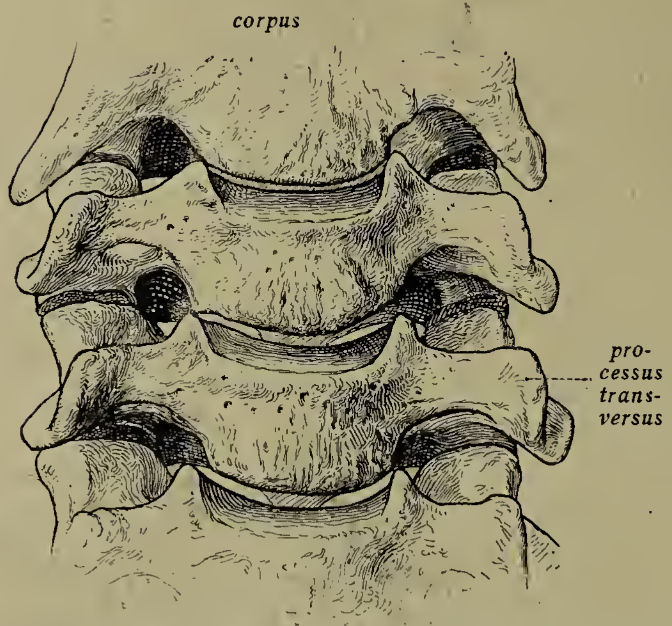

Fig. 3a. Middle cervical vertebrae from in front. The edges of the upper surfaces of the vertebral bodies overlap the lower surface of the next vertebra above.

The **Cervical Vertebrae** have small, transversely elliptical bodies, the upper concave surface of each overlapping laterally the lower convex surface of the vertebra next above. The arches are of moderate height and the vertebral foramen relatively large, especially in its transverse diameter, and of a rounded triangular form. The articulating processes have their almost flat surfaces situated obliquely in a plane intermediate between the frontal and the horizontal. The transverse processes enclose a foramen *(foramen transversarium)* and present on their upper surface a groove for the spinal nerve *(sulcus nervi spinalis),* which extends from the intervertebral foramen over the foramen transversarium to the tip of the process, where it separates an anterior from a posterior tubercle. This is due to the origin of the transverse processes from the pedicles, whence they lie in the regions of the vertebral incisures. The spinous processes are bifid at their tips, except in that of the seventh vertebra *(vertebra prominens),* which inclines downwards like those of the thoracic vertebrae (See Fig. 9).

The **atlas** and **axis** *(epistropheus)* are atypical cervical vertebrae. The atlas has no body. Instead there is both an *anterior* and a *posterior arch.* The vertebral incisures and the spinous process are also lacking. In place of the latter there is a *posterior tubercle* and opposite this on the anterior surface of the anterior arch there is an *anterior tubercle.* In the place of the lacking articular processes there are articulating surfaces on the upper and under surfaces of what are termed the *lateral masses* of the bone. The large transverse processes have a *foramen inter-transversarium,* but no tubercles and no groove for the spinal nerve. The *arch* is low; on the posterior surface of the anterior arch is an articular surface for the *odontoid process (dens)* of the axis *(epistropheus).* The vertebral foramen is very large and consists of a smaller anterior and a larger posterior portion. Over the upper surface of the posterior arch there runs a shallow groove *(sulcus arteriae vertebralis)* for the vertebral artery; occasionally it becomes deeper or is even converted into a canal.

The axis *(epistropheus)* possesses a conical process, the *odontoid process (dens)* arising from its body. Upon this process there is an anterior and usually a posterior articular surface. The upper articular processes are replaced by articulating surfaces and the superior vertebral incisure is wanting. The transverse processes are very small; there are no tubercles and no groove for the spinal nerve. The spinous process is especially strong and bifid and it, as well as the under surface of the bone, resembles the corresponding parts of typical cervical vertebrae.

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*) Seventh Cervical Vertebra, see p. 4—5.

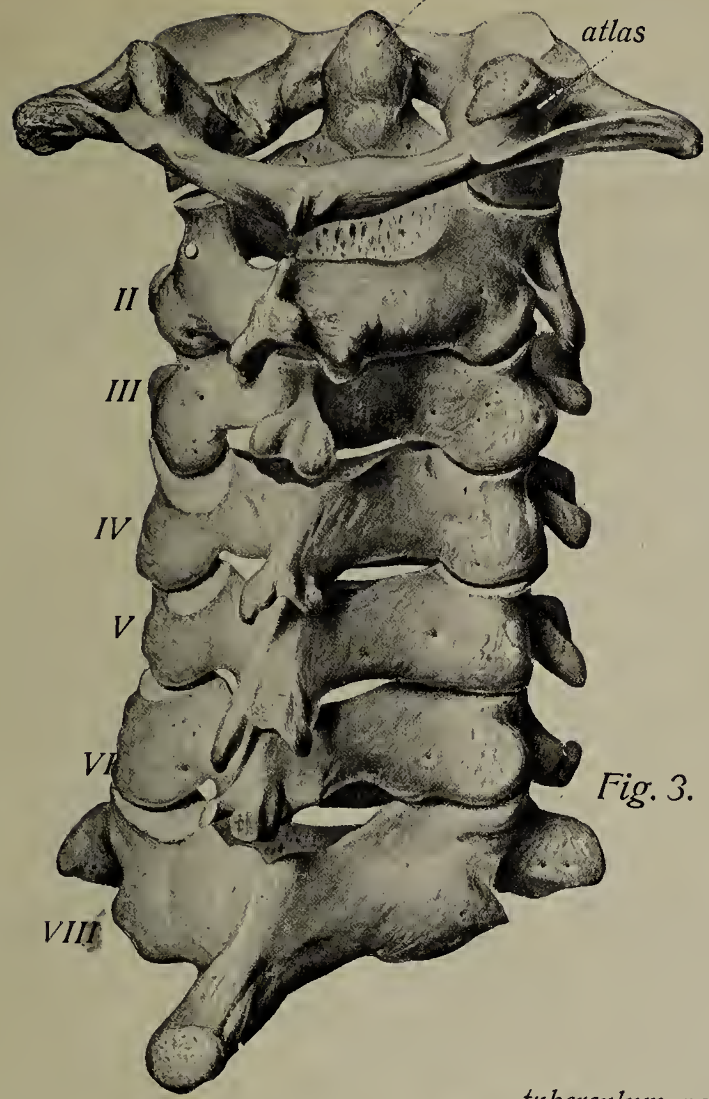

Fig. 3.

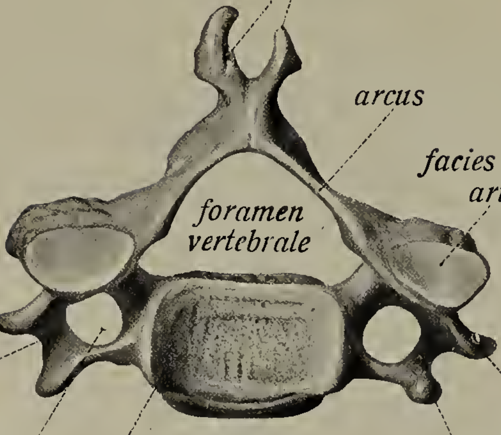

Fig. 4.

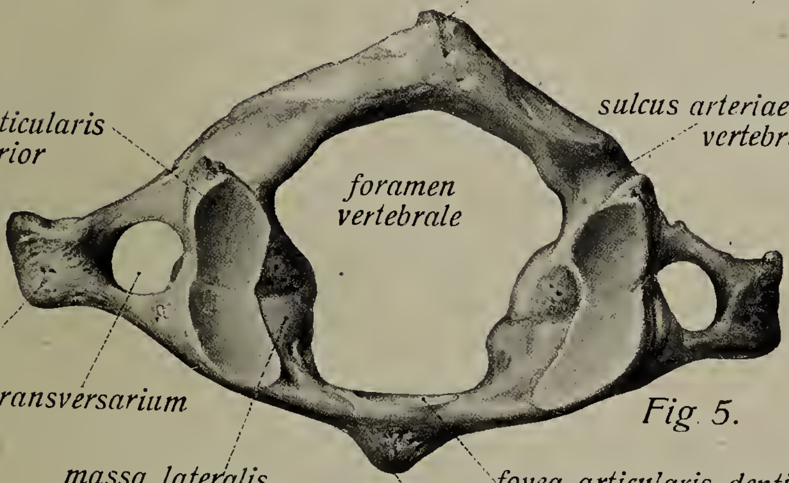

Fig. 5.

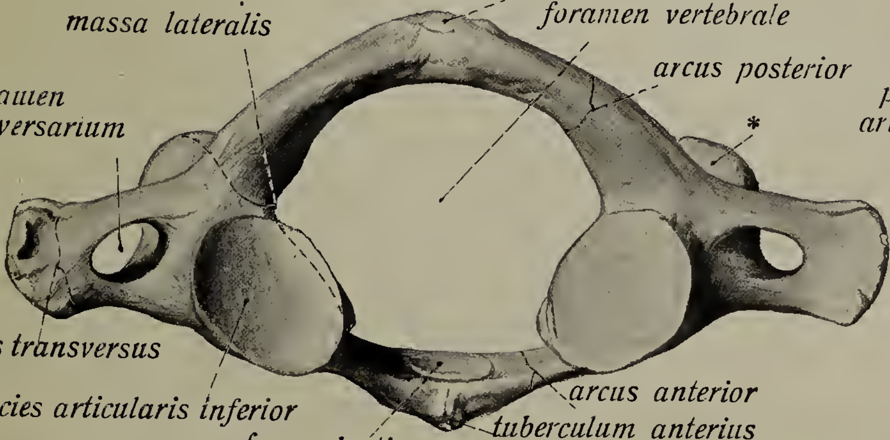

Fig. 6.

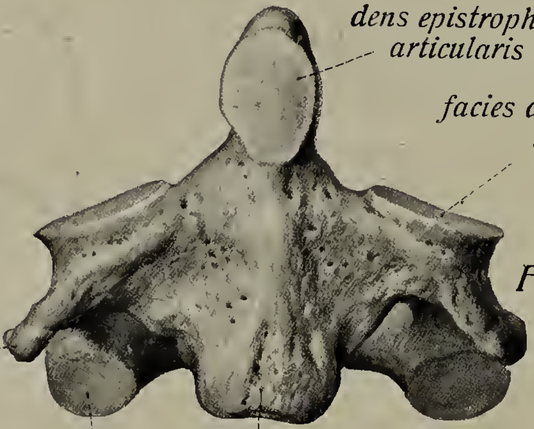
dens epistrophei (facies articularis anterior)
facies articularis superior
processus transversus
facies articularis inferior
corpus

Fig. 7.

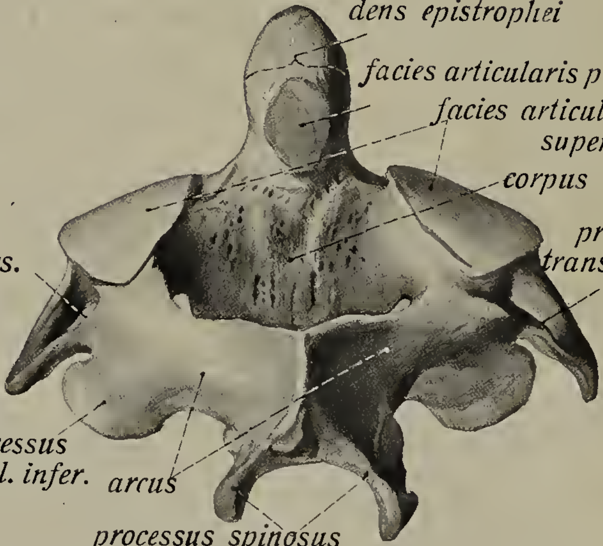
dens epistrophei
facies articularis poster.
facies articulares superiores
corpus
foramen transvers.
proc. transvers.
processus articul. infer.
arcus
processus spinosus

Fig. 8.

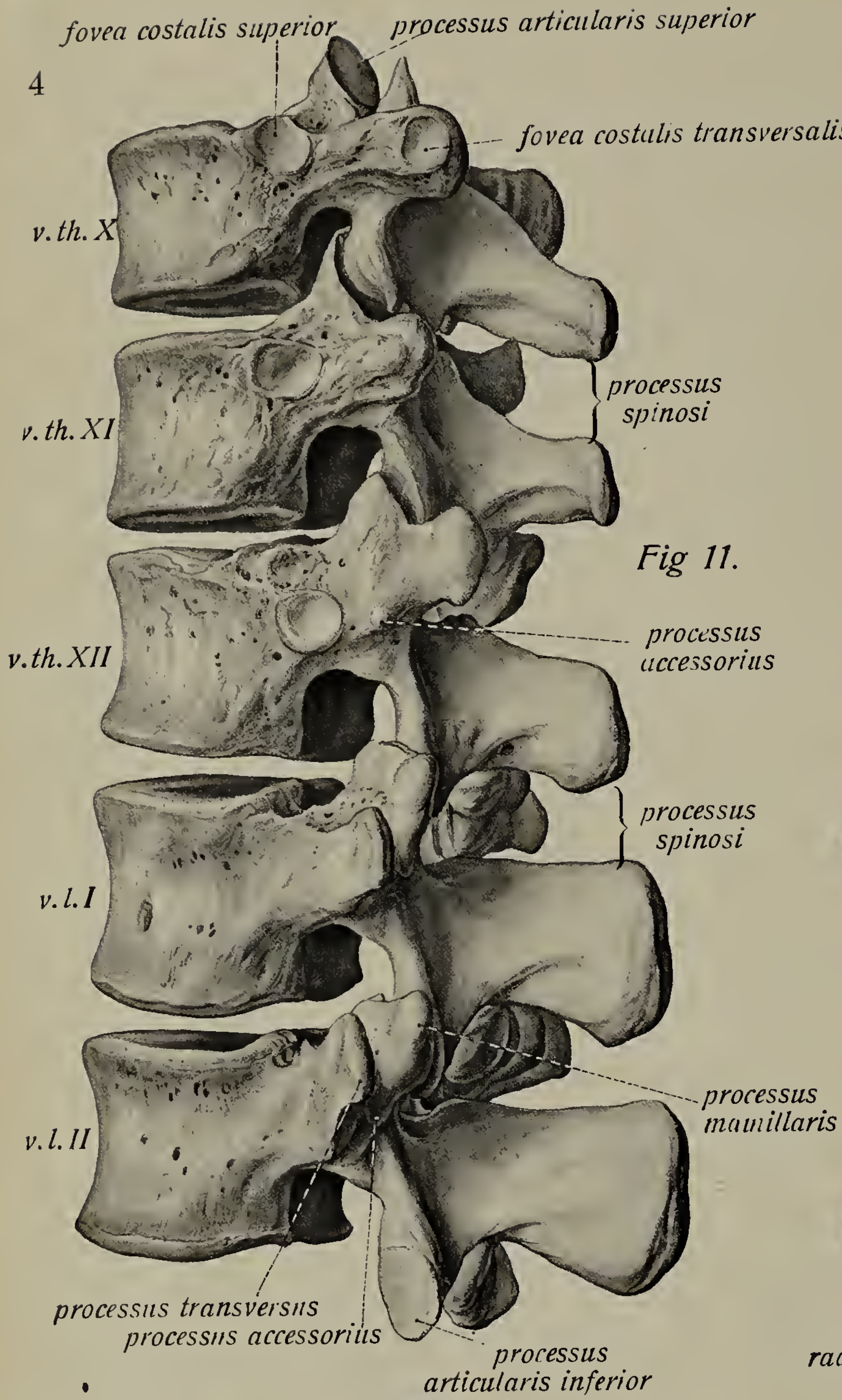

Fig 11.

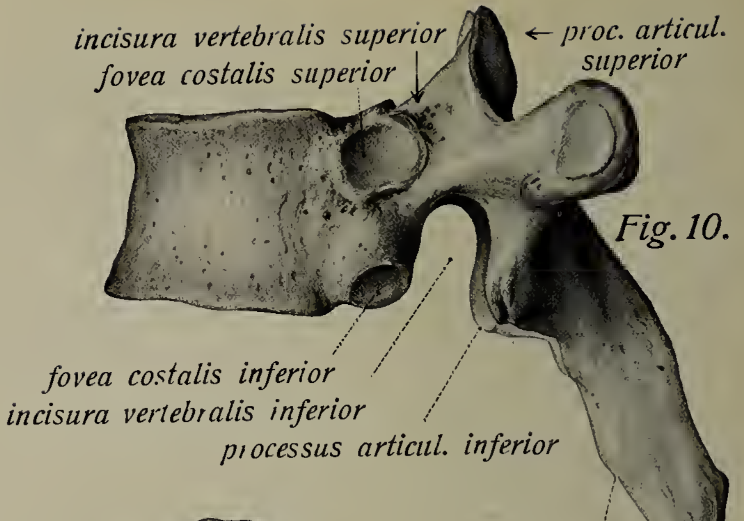
incisura vertebralis superior
fovea costalis superior
← proc. articul. superior
fovea costalis inferior
incisura vertebralis inferior
processus articul. inferior
processus spinosus

Fig. 10.

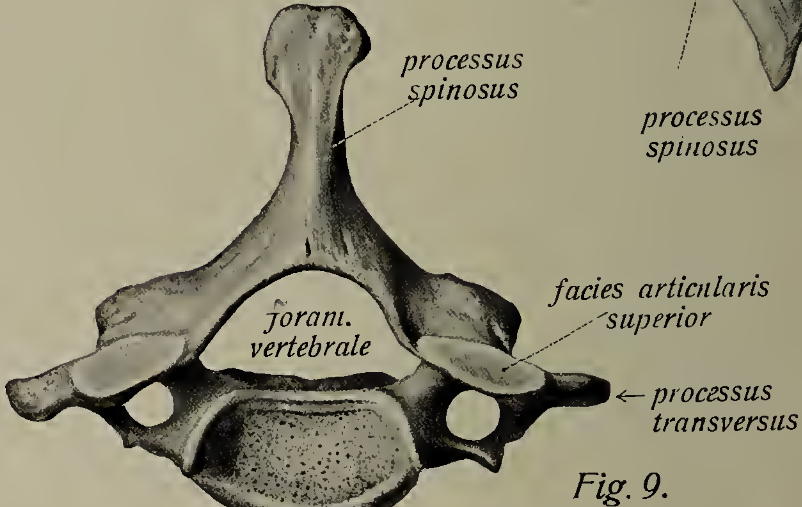

Fig. 9.

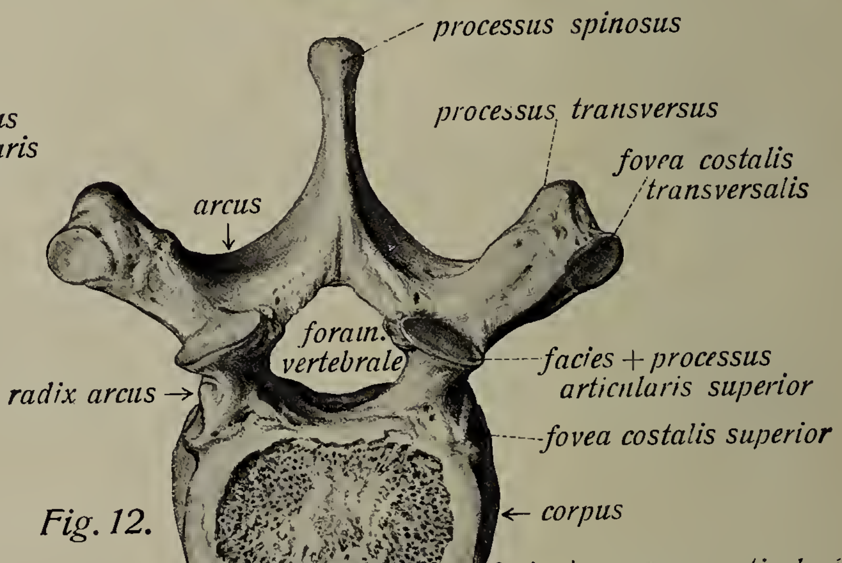

Fig. 12.

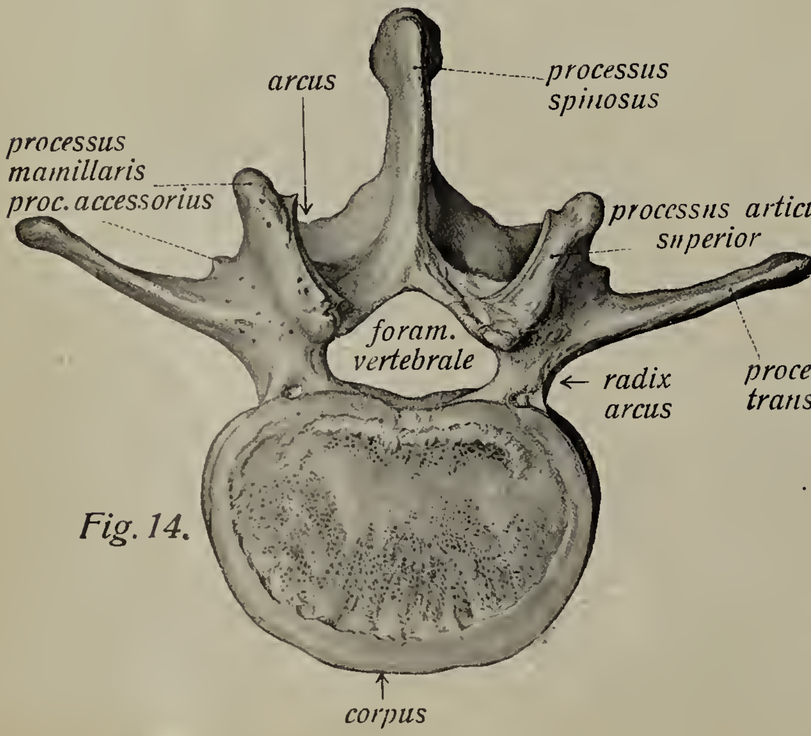

Fig. 14.

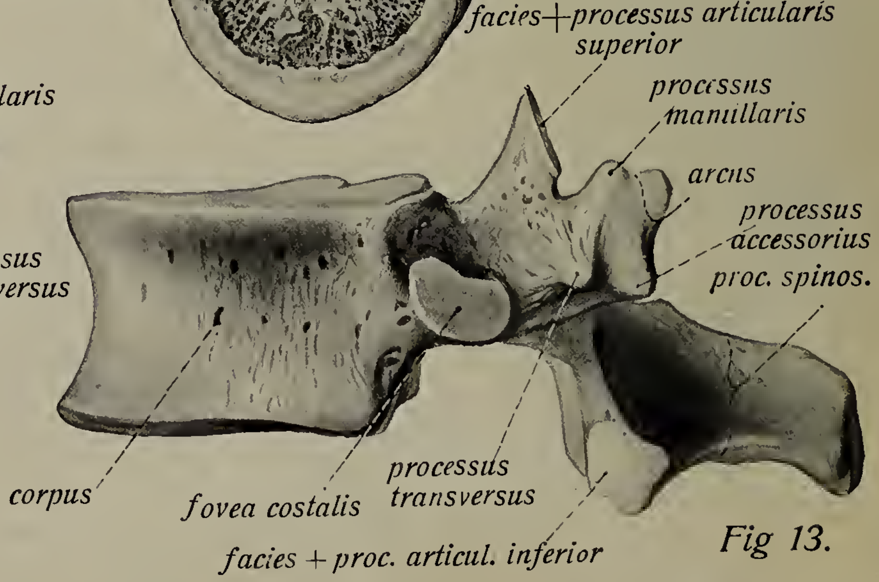

Fig 13.

The Thoracic and Lumbar Vertebrae.

Fig. 9. The seventh cervical vertebra seen from above. ($^1/_1$)
Fig. 10. The sixth thoracic vertebra from the left side. ($^1/_1$)
Fig. 11. The tenth to the twelfth thoracic and the first and second lumbar vertebrae from the side and slightly from behind.
(The 12th. thoracic vertebra in this case had a well developed transverse process.) ($^3/_4$)
Fig. 12. The tenth thoracic vertebra from above. ($^1/_1$)
Fig. 13. The twelfth thoracic vertebra from the left side.
(Transverse process rudimentary.) ($^1/_1$)
Fig. 14. The third lumbar vertebra from above. ($^2/_3$)
v. th = thoracic vertebra, v. l. = lumbar vertebra.

The **thoracic vertebrae** have moderately large bodies which increase both in height and depth from above downwards. The surfaces of the *bodies* are flat and heart-shaped. The *vertebral foramen* is absolutely and relatively small and almost circular. On the posterior part of both the upper and lower borders of the lateral surfaces of the body are articular facets *(fovea costalis superior* and *inferior)*, which, with the corresponding facets of adjacent vertebrae, form the articular surface for the heads of the ribs. The *articular processes* have nearly flat surfaces which lie almost in the frontal plane; the lower ones hardly project beyond the surface of the arches. The *transverse processes* are strong, directed laterally and backward and bear upon the anterior surfaces of their thickened, free ends articular surfaces for the tubercles of the ribs *(foveae costales transversales)*.

The *spinous processes* are very strong, triangular and directed distinctly downwards; those of the middle thoracic vertebrae overlap each other like the shingles on a roof.

The last two and usually also the first thoracic vertebrae each unite with only one rib and consequently have on each side only one costal fovea. The eleventh and especially the twelfth thoracic vertebrae form a gradual transition to the lumbar vertebrae, since the spinous processes are directed backwards and are laterally compressed, the foveae costales transversales are lacking and, associated with a rudimentary condition of the transverse processes, accessory and mamillary processes may occur. Also the articular surfaces and the lower articulating processes of the twelfth thoracic vertebra are already sagittal in position.

The **lumbar vertebrae** are the largest of all the true vertebrae. They have high and broad bodies with flat, bean-shaped, not quite parallel surfaces, as well as high and strong arches with very strong processes. The anterior surfaces of the bodies are hollowed out. In size these vertebrae increase continuously from the first to the fifth. The *vertebral foramen* is narrow and rounded triangular. The surfaces of the *articular processes* stand almost in the sagittal plane; they are distinctly curved, the superior processes being concave and directed medially while the inferior are convex and directed laterally.

The upper articular processes bear on their upper margins a rounded tubercle, the *mamillary process*. The *transverse processes* are long, flat, rib-like and directed almost exactly laterally. At the base of each is a sharp process directed backwards, the *accessory process*. The *spinous processes* are strongly compressed laterally and are directed almost exactly backwards.

The Sacrum.

The *sacrum* is a curved, shovel-shaped bone, broader above and narrower below. Its posterior surface *(facies dorsalis)* is convex and roughened, the anterior surface *(facies pelvina)* is concave and relatively smooth, the broader upper surface is termed the *base* and the lower more pointed end the *apex*.

The *dorsal surface* presents a rough median ridge or crest, which in many cases is frequently interrupted. It is formed by the fusion of the spinous processes of five sacral vertebrae. In addition to this unpaired median crest there are on the dorsal surface on each side two lateral, rarely continuous ridges, which are separated by four foramina, the *posterior sacral foramina*. Medial to these foramina lies the *sacral articular crest* formed by the fusion of the articular processes and lateral is a crest *(crista sacralis lateralis)* formed by the fusion of the transverse processes. The upper articular process of the first sacral vertebra remains distinct for articulation with the last lumbar vertebra, while the lower process of the last sacral vertebra forms a process, the *sacral cornu*, for articulation with the coccyx. The two sacral cornua bound the lower opening *(hiatus sacralis)* of the canal contained within the sacrum *(canalis sacralis)*.

The *pelvic surface* presents four pairs of anterior sacral foramina corresponding to but larger than the four posterior foramina. Extending between the foramina of each pair is a low, rough ridge *(linea transversa)*, which indicates the boundary between the bodies of two fused sacral vertebrae. The anterior foramina diminish in size from above downwards.

The *apex* of the sacrum appears as if cut off and possesses a small elliptical surface to which the coccyx is apposed.

The *base* shows a surface corresponding with the under surface of the last lumbar vertebra, with which it articulates. Between this bean-shaped surface and the superior articular process is a *superior vertebral incisure*, which with the inferior incisure of the last lumbar vertebra, forms the last intervertebral foramen. Behind the surface for the last lumbar vertebra lies the upper end of the sacral canal and laterally are the *lateral masses*. The base of the sacrum is separated from the concave pelvic surface by a feeble line, which is the sacral part of the *linea terminalis*.

Fig. 15. The sacrum from behind (facies dorsalis). $({}^3/_4)$

Fig. 16. The sacrum from in front (facies pelvina). $({}^3/_4)$

Fig. 17. The sacrum from above (base). $({}^3/_4)$

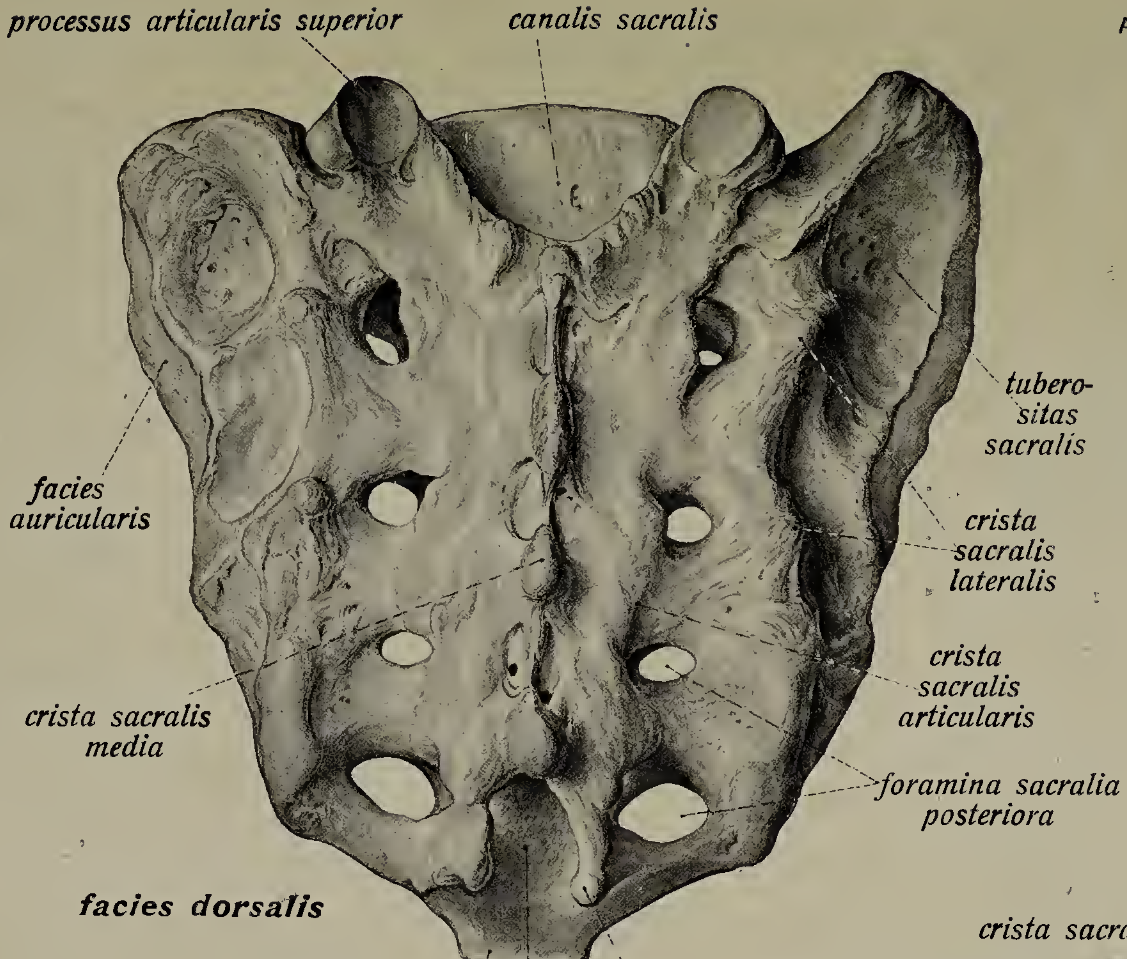
processus articularis superior
canalis sacralis
facies auricularis
tuberositas sacralis
crista sacralis lateralis
crista sacralis media
crista sacralis articularis
foramina sacralia posteriora
facies dorsalis
apex ossis sacri
hiatus (canalis) sacralis
cornu sacrale

Fig. 15.

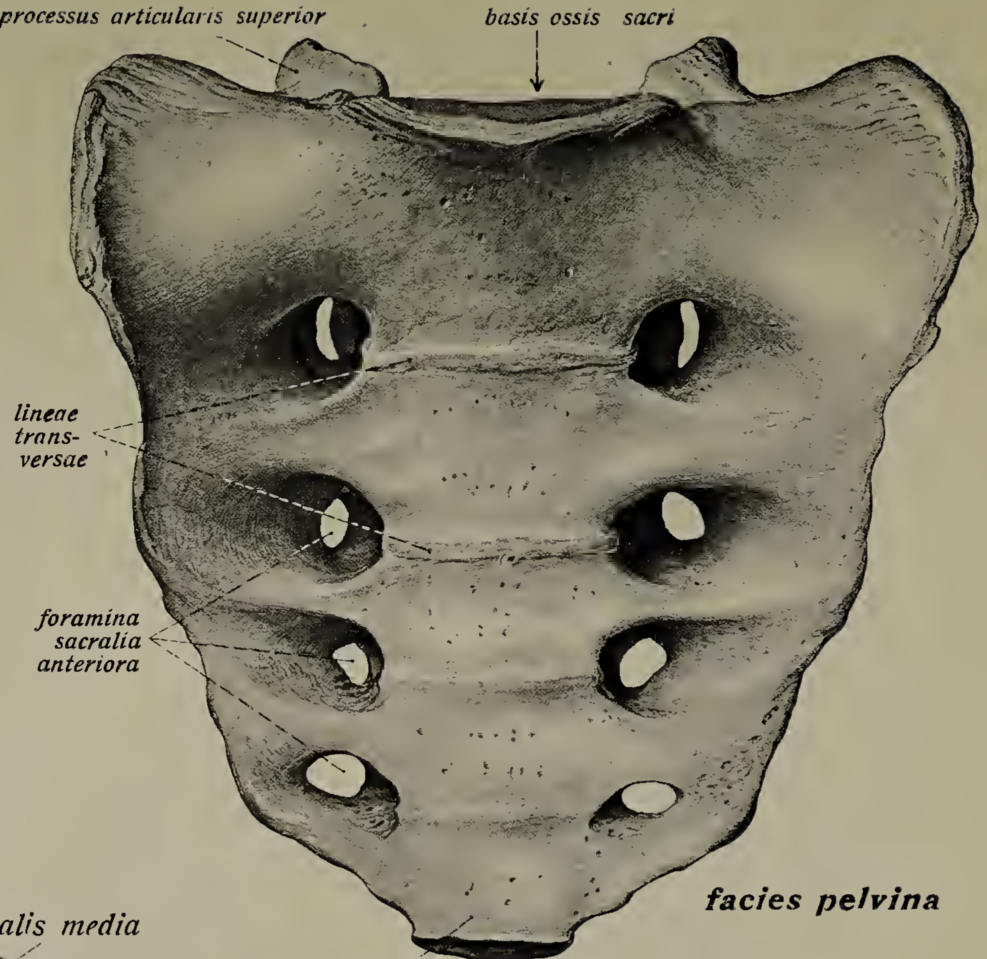

Fig. 16.

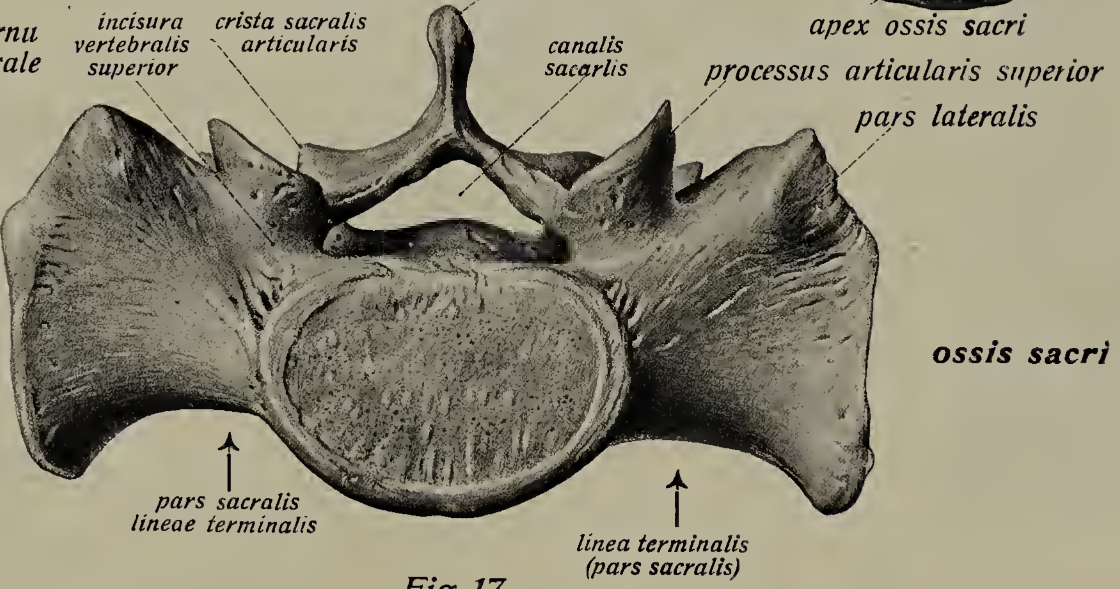
crista sacralis media
incisura vertebralis superior
crista sacralis articularis
canalis sacarlis
processus articularis superior
pars lateralis
basis
ossis sacri
pars sacralis lineae terminalis
linea terminalis (pars sacralis)

Fig 17.

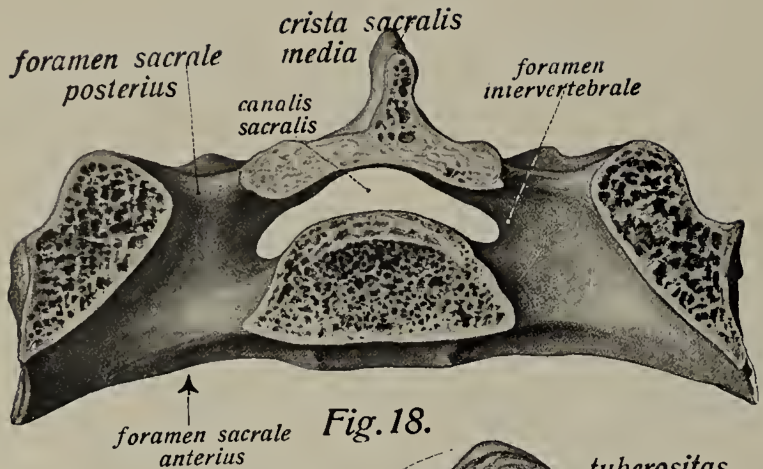

Fig. 18.

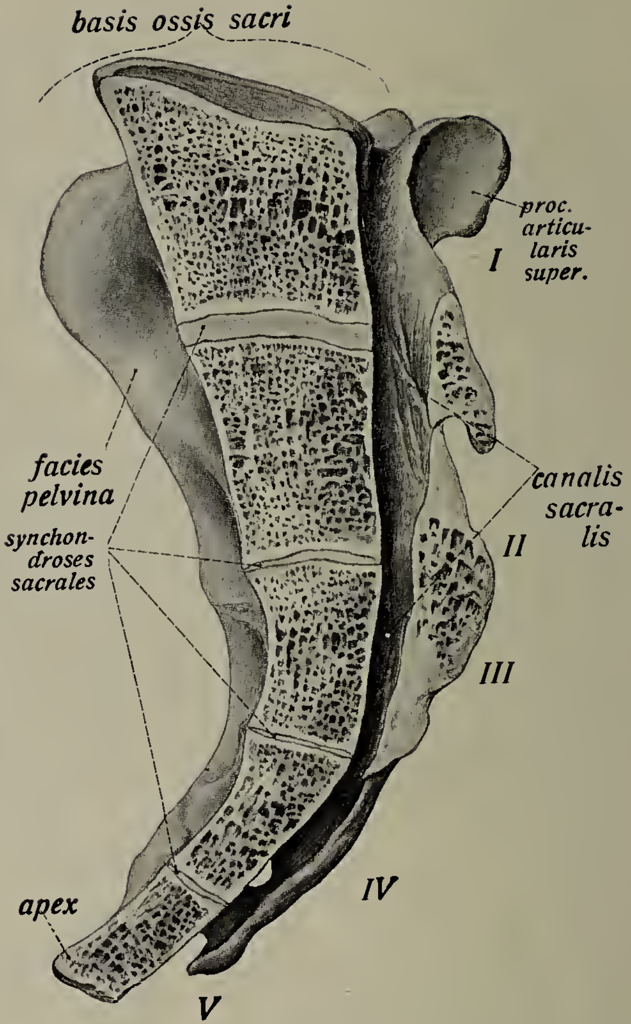

Fig. 19.

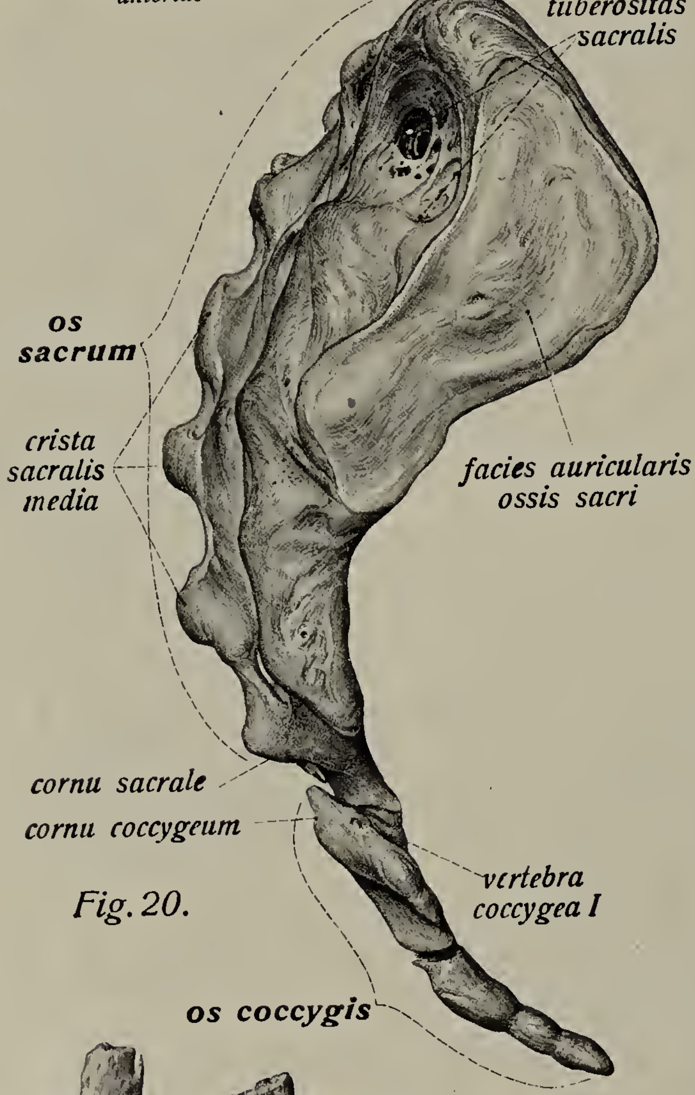

Fig. 20.

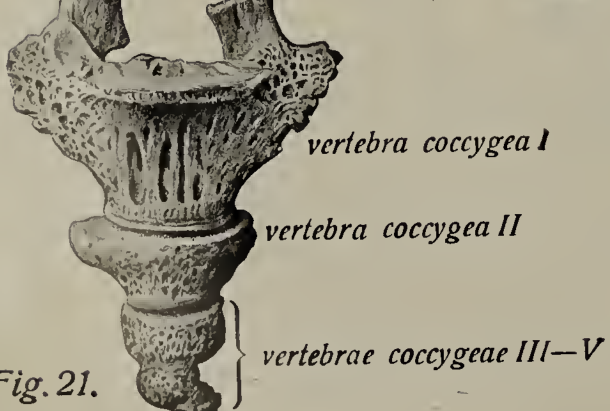

Fig. 21.

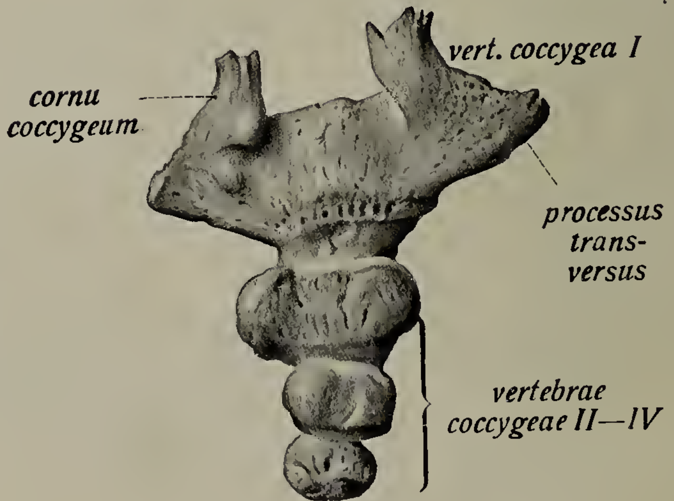

Fig. 22.

The Sacrum (Cont.) **and Coccyx.**

Fig. 18. Horizontal section through the sacrum at the level of the second foramina. ($^3/_4$)
Fig. 19. Median longitudinal section of a young sacrum showing the synchondroses between the individual vertebrae. ($^3/_4$)
Fig. 20. Sacrum and coccyx from the right side. ($^3/_4$)
Fig. 21. Coccyx composed of five vertebrae, from in front. ($^1/_1$)
Fig. 22. Coccyx composed of four vertebrae, from behind. ($^1/_1$)

In a lateral view of the sacrum one sees the articulating surface of the lateral mass, which serves for articulation with the innominate bone and through this for the completion of the pelvic limb-girdle. It is formed anteriorly by an uneven, ear-shaped *auricular surface,* which is covered with cartilage, and posteriorly by a rough, depressed area, the *sacral tuberosity,* which is not covered by cartilage. Below this the lateral surface of the bone, which is fairly broad above, becomes exceedingly narrow.

The *sacral canal* traverses the entire length of the sacrum. Posteriorly it is bounded by a flattened bony mass formed by the fused arches of the sacrum, which bear the medial sacral crest. The canal opens in front and behind into the sacral foramina by means of the intervertebral foramina, which, in the sacrum, in contrast to the true vertebrae, are contained within the bone and consist of short canals. The posterior wall of the sacral canal does not extend to the apex of the bone, but terminates at about the boundary between the fourth and fifth sacral vertebrae. There is thus formed the *hiatus* of the sacral canal.

The **Coccyx** is a small bone formed by the fusion of four or five rudimentary *coccygeal vertebrae.* The first of these vertebrae possesses two upwardly projecting cornua which are the rudiments of articular processes and serve for articulation with the sacrum. Furthermore, this same vertebra has feebly developed *transverse processes.* The upper end of the coccyx unites with the apex of the sacrum.

The second to the fifth (sixth) coccygeal vertebrae represent merely the bodies of these vertebrae and are usually irregular in shape. The individual coccygeal vertebrae are either united with one another by synchondroses or have a bony union.

The Vertebral Column.

Fig. 23. The vertebral column from in front. ($^1/_3$)
Fig. 24. The vertebral column from behind. ($^1/_3$)
Fig. 25. The vertebral column from the left side.

(In this case the costal facet on the transverse process is wanting in the tenth thoracic vertebra.) ($^1/_3$)

The *vertebral column* is a bony column with several curvatures and is composed of 26 separate bones, i. e. 24 true vertebrae, the sacrum and the coccyx. Its curvatures are as follows: — one in the cervical region slightly convex anteriorly, one in the thoracic region strongly concave anteriorly, one in the lumbar region strongly convex anteriorly and one in the sacral and coccygeal regions strongly concave anteriorly.

The width of the column is greatest at the upper part of the sacrum; from this level the vertebrae become gradually smaller toward the coccyx and also upwards toward the middle of the thoracic region. From there upwards the vertebrae again broaden to the upper thoracic and lower cervical regions, diminishing again up to the axis *(epistropheus),* while the atlas, with its strongly developed transverse processes, is again notably broader. The greatest thickness of the column is in the lumbar region. The bodies of the vertebrae are not in actual contact with one another, but are joined together by intervertebral discs. On the other hand the articular processes are in immediate contact by their articular surfaces. Each adjacent pair of *vertebral incisures* form an *intervertebral foramen;* the uppermost pair of these lies between the second and third cervical vertebrae and the lowest pair between the fifth lumbar vertebra and the sacrum, so that there are altogether 23 pairs of foramina. They are largest in the lumbar region and smallest in the thoracic. In the cervical region the foramina lie in the intervals between the transverse processes, in the thoracic and lumbar regions they are anterior to these processes.

The intervertebral foramina lead into the *vertebral canal,* which represents the sum of the separate vertebral foramina and is an almost cylindrical cavity that begins at the atlas and is continued below into the sacral canal.

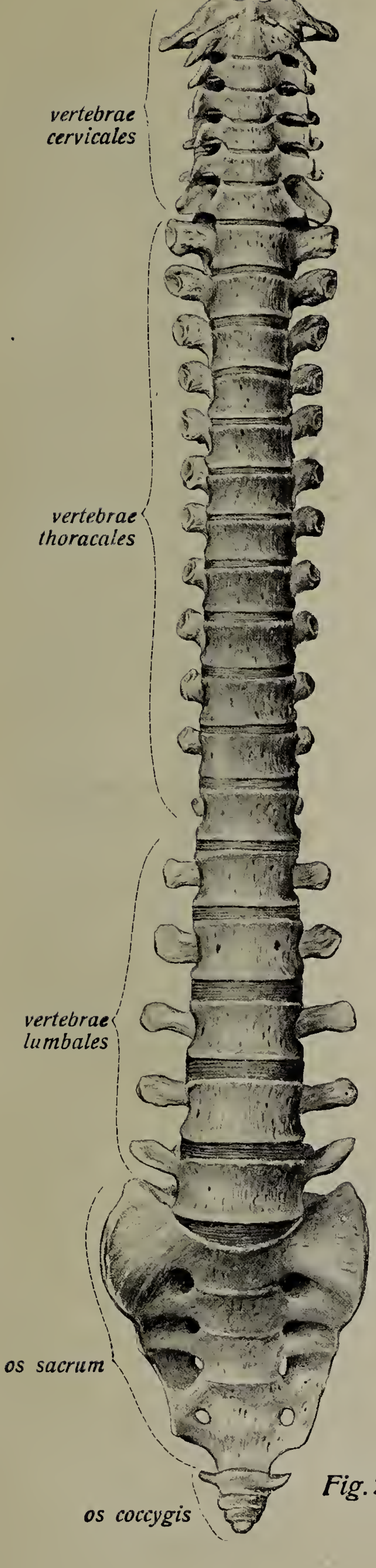

Fig. 23.

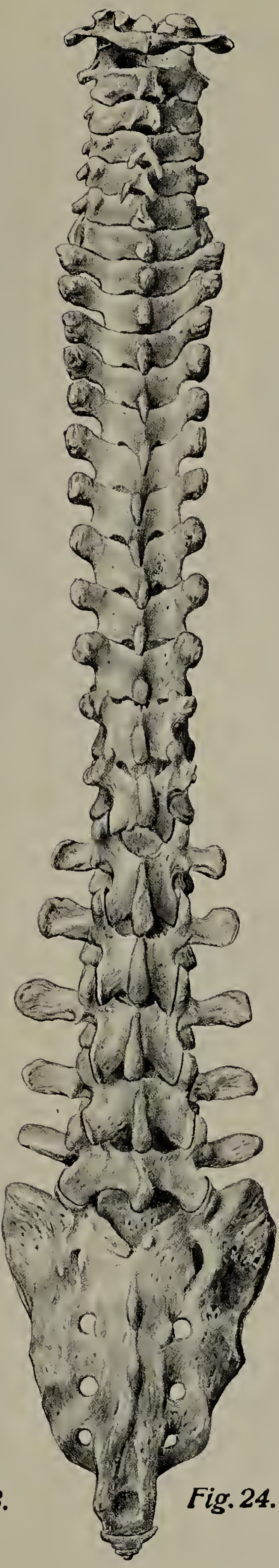

Fig. 24.

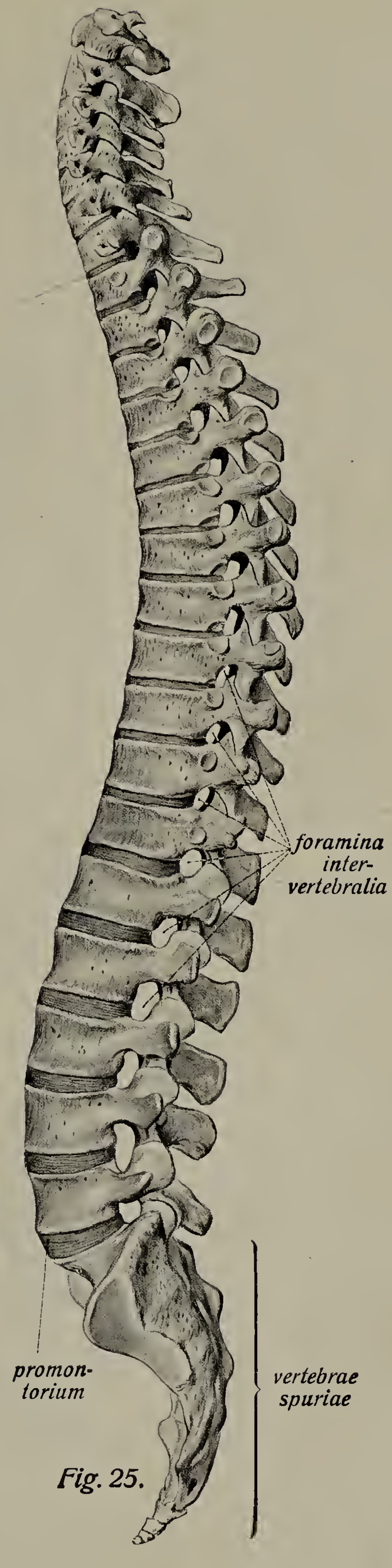

Fig. 25.

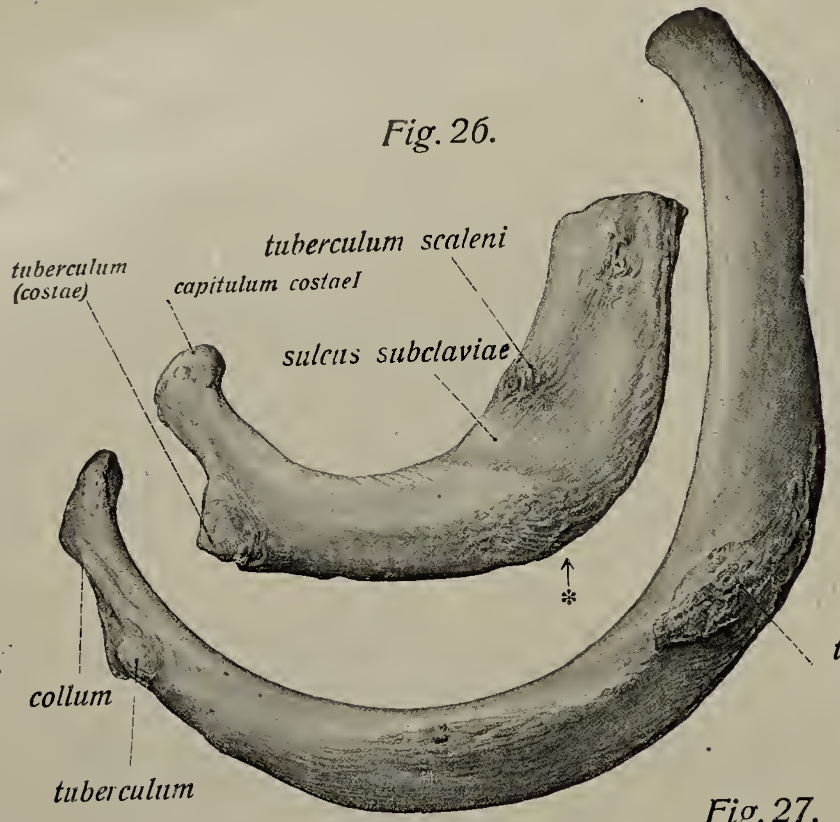

Fig. 26.

Fig. 27.

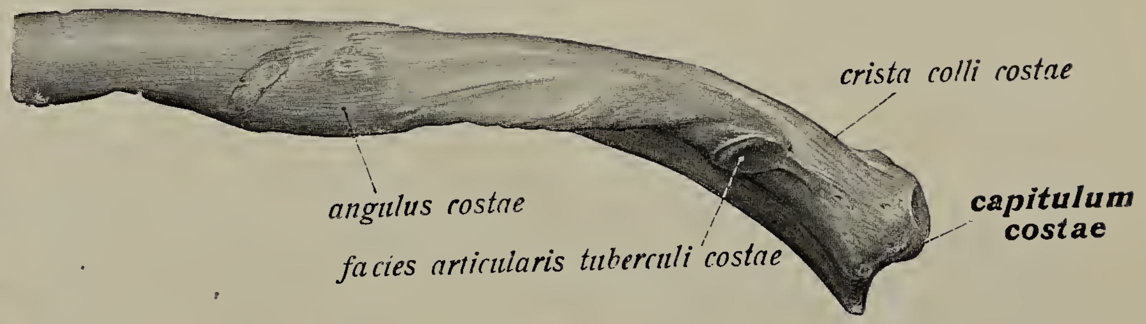

Fig. 28.

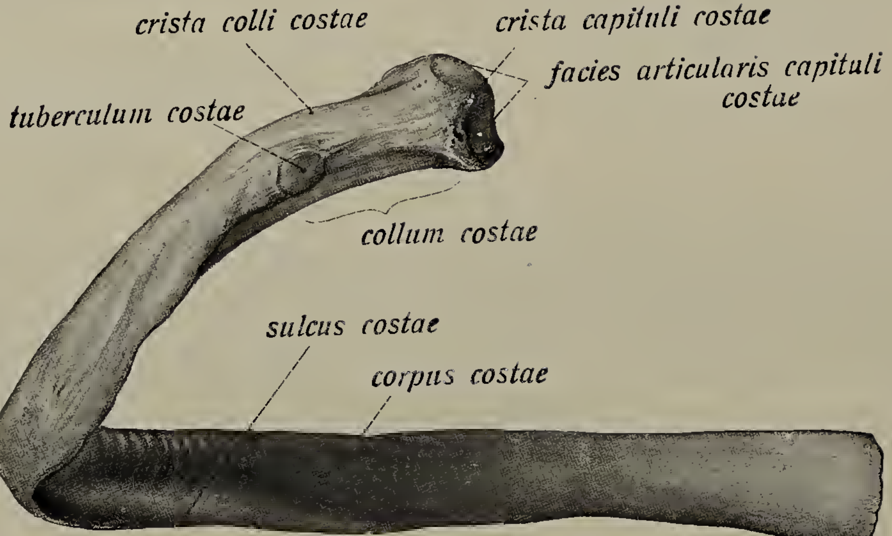

Fig. 29.

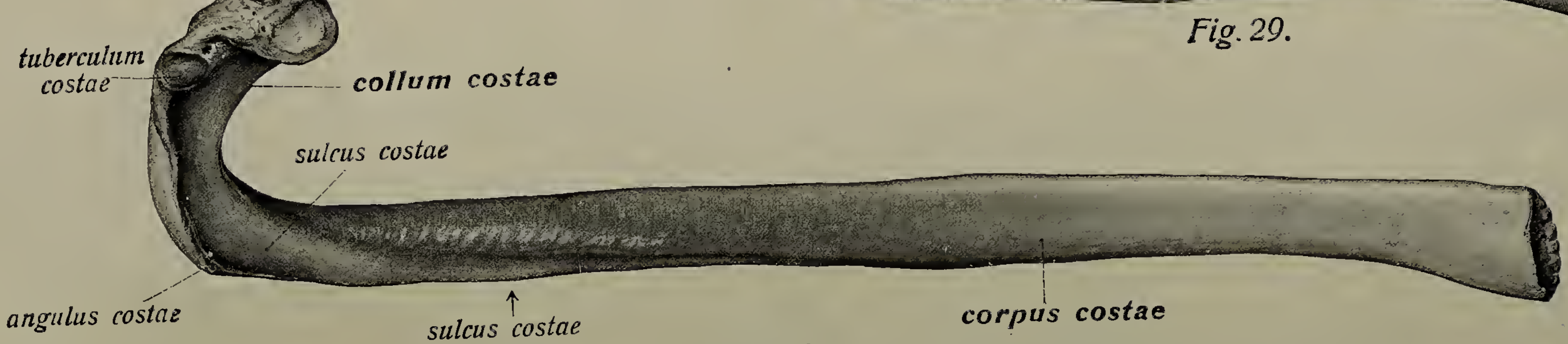

Fig 30.

The Ribs *(costae).*

The *ribs (costae)* are long flat bones and may be regarded as consisting of a bony rib and a costal cartilage. In the bony rib there may be noted a rounded enlargement at the posterior, vertebral end, the *head (capitulum),* with an articular surface for articulation with the vertebral bodies. This surface, at least in the ribs that articulate with the bodies of two vertebrae, is divided into two portions by the *capitular crest.* On the head there follows a distinct constriction of the rib, the *neck (collum),* whose upper border is provided with a *ridge (crista colli)* that gradually fades out on the body of the rib. Where the neck passes over into the body of the rib there is a rough tubercle bearing an articular surface for articulation with the transverse process of a thoracic vertebra.

The *body (corpus)* of the rib forms the principal part of the bony rib. It is a long, flat, vertically placed bone curved in correspondence with the curvature of the thorax. Near the tubercle it presents a rough surface, the angle of the rib, and at this point the rib, which at first was directed somewhat backwards, bends anteriorly. At the lower border, or more exactly, on the inner surface of the body, is a groove *(sulcus costae),* which gradually fades out toward the anterior end of the rib. This is slightly hollowed out for the reception of the costal cartilage.

The third to the tenth bony ribs have a typical form. The first and second and the eleventh and twelfth are atypical.

The **first rib** is short and broad. It is not placed vertically, but almost horizontally and its surfaces are directed upwards and somewhat outwards, and downwards and somewhat inwards. As a rule it has no capitular crest and no angle. On its upper surface, not far from where it joins its costal cartilage, there is a distinctly roughened area, the *scalene tubercle,* and behind this a slight furrow, the *subclavian groove* for the subclavian artery. Behind this again is a rough surface for the insertion of the scalenus medius. The neck of the first rib is long and thin.

The **second rib** is markedly longer and smaller than the first. Its posterior part is similar to that of the first, one surface looking upward and outward and the other downward and inward, but its anterior part is placed nearly vertical, as are the typical ribs. The angle and the tubercle coincide, but on the other hand there is a capitular crest. At about the middle of the length of the rib its lateral surface shows a roughened area, the tuberosity, for the insertion of a serration of the serratus anterior.

Fig. 26. The right first rib, from above and lateral. ($^{3}/_{4}$) * = roughness for the scalenus medius.
Fig. 27. The right second rib, from above and lateral. ($^{3}/_{4}$)
Fig. 28. The posterior end of the left seventh rib, from behind and somewhat from below. ($^{2}/_{3}$)
Fig. 29. The left seventh rib, from behind. ($^{2}/_{3}$)
Fig. 30. The left seventh rib, from within (medial). ($^{2}/_{3}$)

The Ribs *(costae) (Cont.)* and Sternum.

Fig. 31. The eleventh rib of the left side, seen from behind. ($^3/_4$)
Fig. 32. The twelfth rib of the left side, from behind. ($^3/_4$)
Fig. 33. The sternum from in front. ($^1/_2$)
Fig. 34. The sternum from the left side. ($^1/_2$)

The *eleventh* and *twelfth ribs* are quite rudimentary. They possess only a head, which however has no capitular crest. The tubercle is usually wanting on the eleventh rib and frequently the angle; on the twelfth rib also both are wanting. In both the costal sulcus is absent. The twelfth rib is often very short and it varies greatly in length.

The Sternum.

The *sternum* is a flat, elongated bone in which three parts may be recognized, a *manubrium,* a *body (corpus)* and a *xiphoid process.*

The *manubrium* is the upper, broadest, slightly curved portion of the sternum and is separated from the body of the bone by the sternal synchondrosis. There may be distinguished on the manubrium an upper, shallow depression, the *jugular notch* or *incisure,* lateral to which on the two upper angles of the bone are two lateral, stronger depressions, the *clavicular incisures,* for the reception of the sternal ends of the clavicles. Immediately below these lie two broad shallow depressions, the *first costal incisures*, for the attachment of the cartilage of the first rib. At the lower end of the manubrium there is on either side a half incisure for the second rib.

The *body (corpus)* of the sternum is narrower but longer than the manubrium. For the most part it broadens from above downwards. It unites with the manubrium at a very obtuse angle, the *sternal angle,* which is not always very distinct. Its anterior surface is termed the *sternal plane.* The lateral borders show incisures for the reception of the second to the seventh costal cartilages. Frequently low transverse ridges upon the anterior surface of the bone unite the incisures of the two sides (See Fig. 36). Only the lower half of the incisure for the second rib is found on the body of the sternum, the incisures for the fifth to the seventh lie close to one another, while those for the second to the fifth rib are placed at quite distinct intervals. That for the seventh rib is in the angle between the body and the xiphoid process.

The *xiphoid process* is usually only partly bony, being usually cartilaginous in its lower part. It is often perforated or cleft below and is especially variable in form. Its upper bony portion usually fuses with the body of the sternum in advancing years.

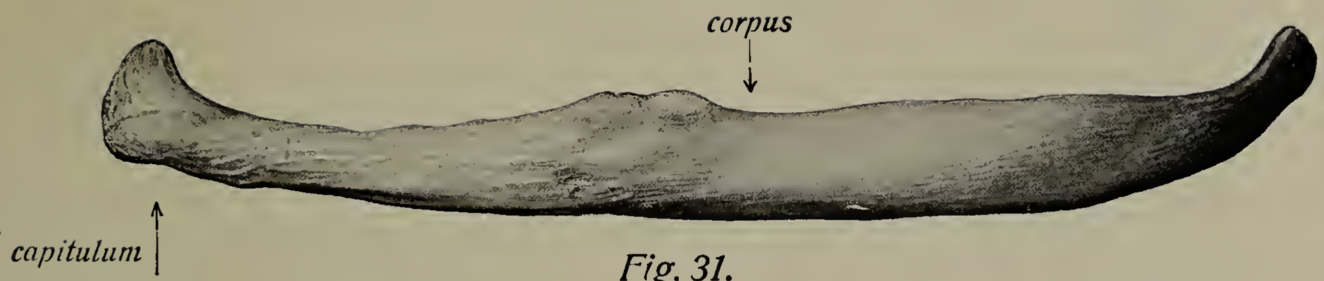

Fig. 31.

Fig. 32.

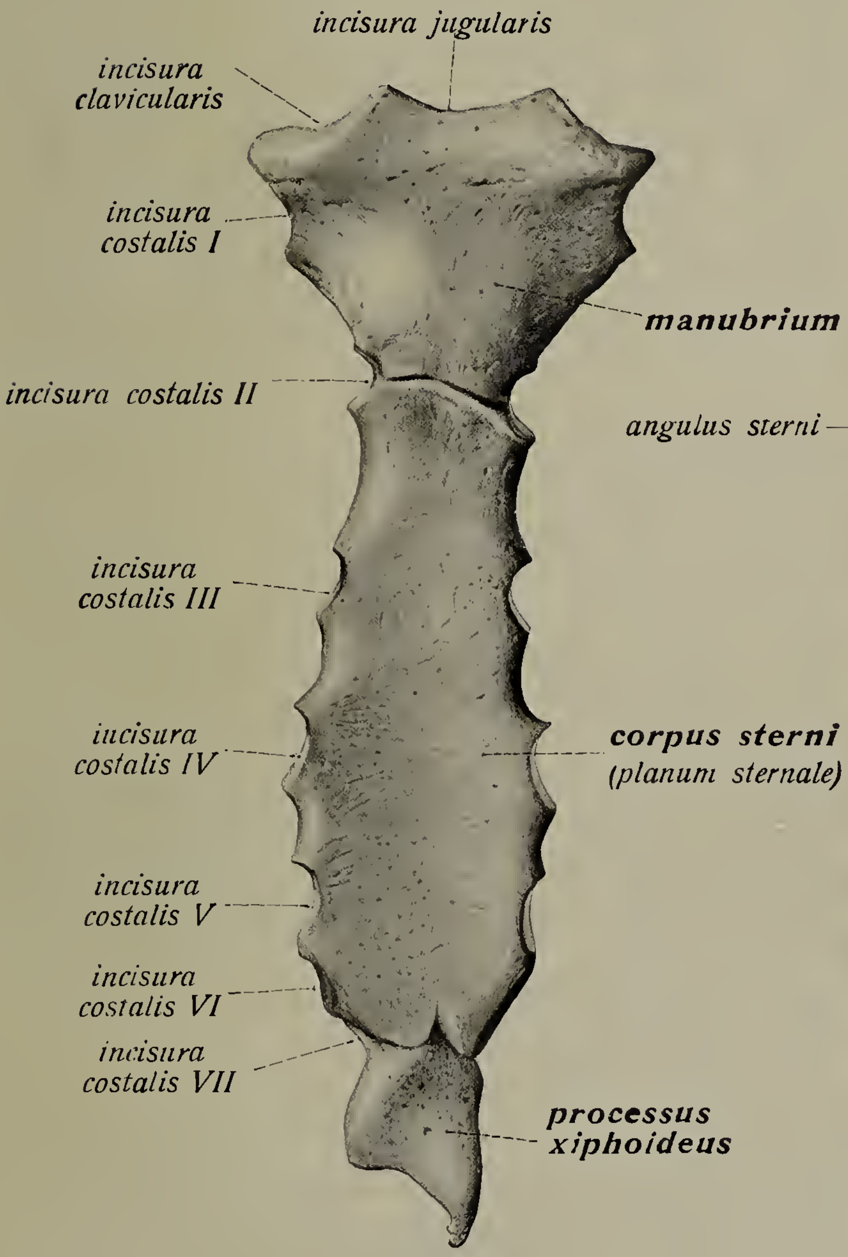

Fig. 33.

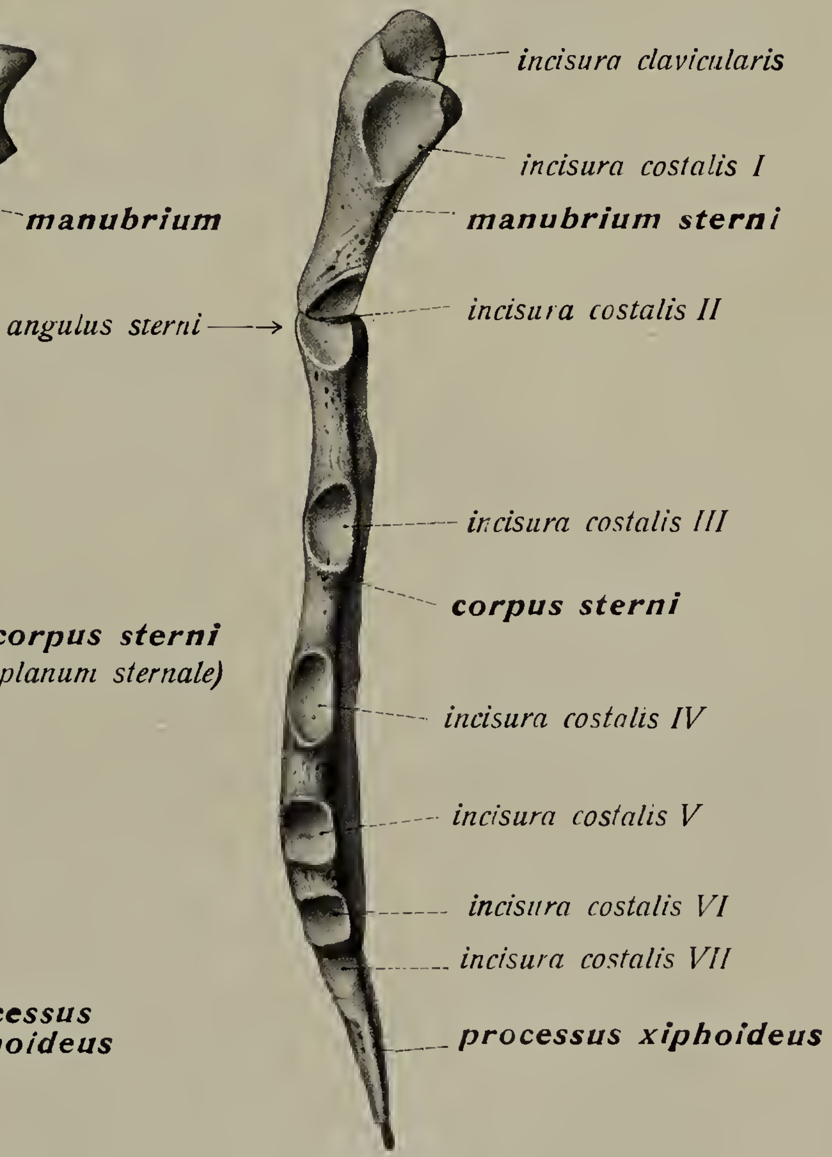

Fig. 34.

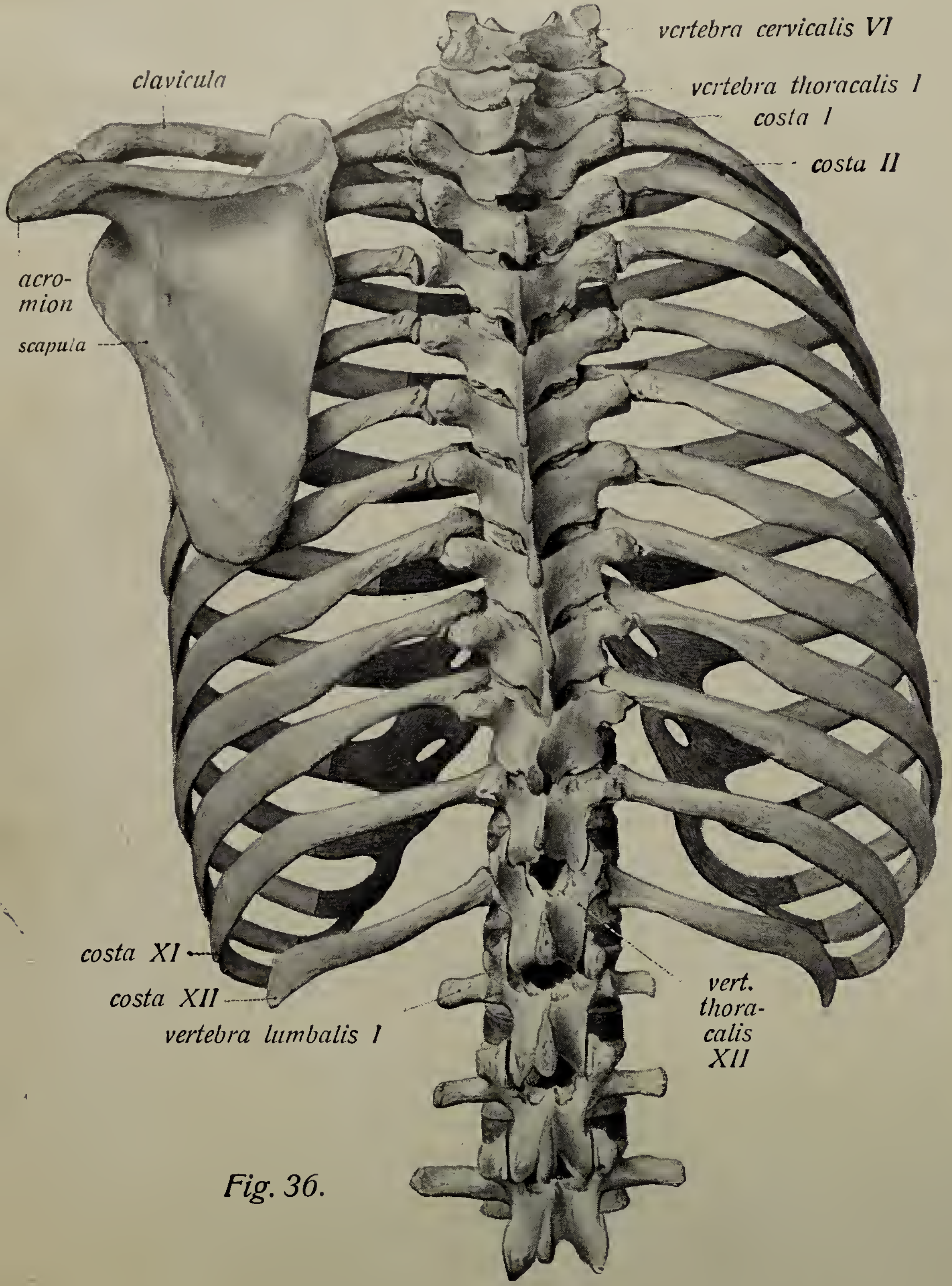
vertebra cervicalis VI
clavicula
vertebra thoracalis I
costa I
costa II
acro-
mion
scapula
costa XI
costa XII
vertebra lumbalis I
vert.
thora-
calis
XII

Fig. 36.

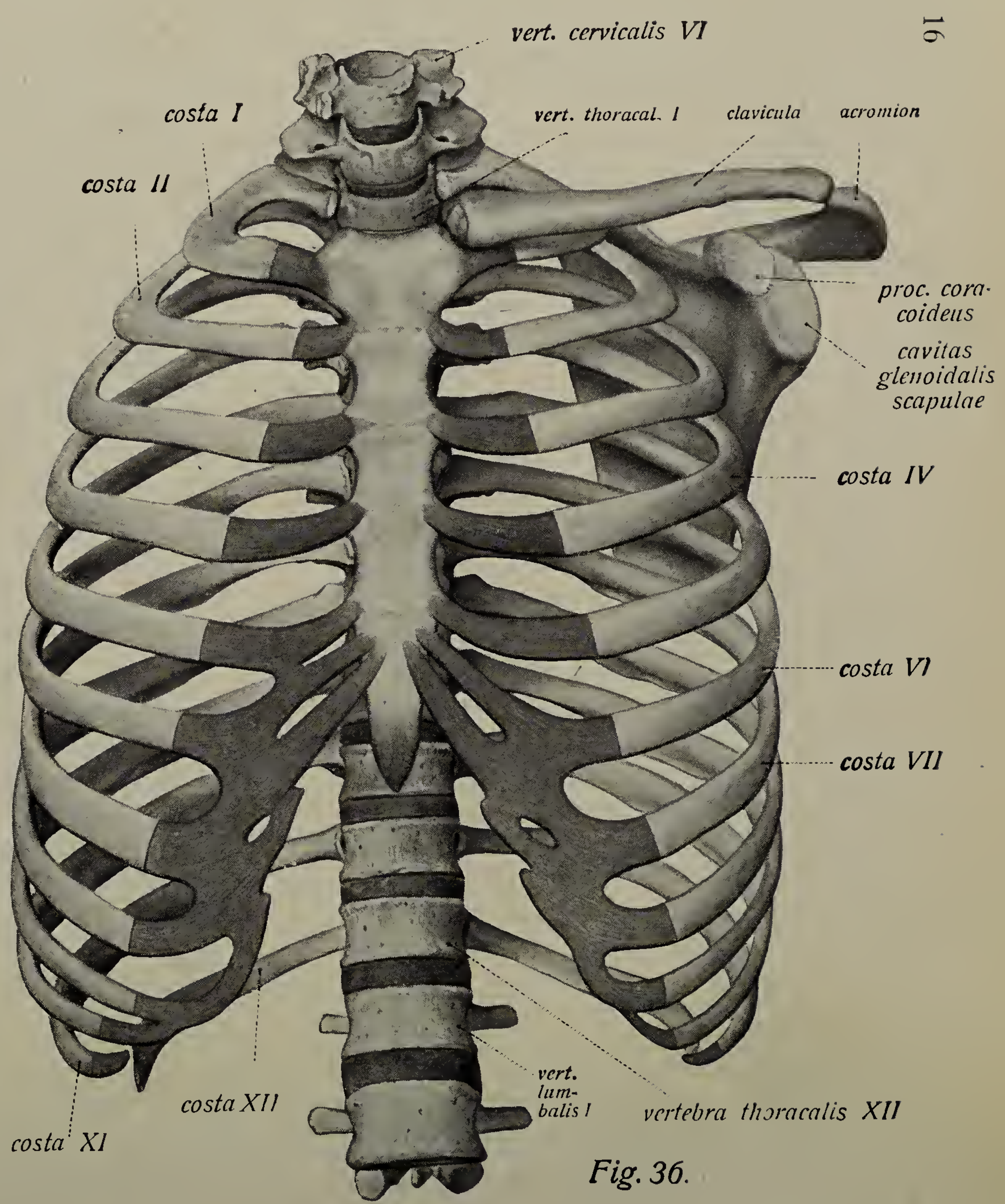
vert. cervicalis VI
costa I
vert. thoracal. I
clavicula
acromion
costa II
proc. cora-
coideus
cavitas
glenoidalis
scapulae
costa IV
costa VI
costa VII
costa XII
costa XI
vert.
lum-
balis I
vertebra thoracalis XII

Fig. 36.

The Thorax.

The *thorax* is formed by the twelve thoracic vertebrae, the twelve pairs of ribs and the sternum.

The ribs increase in length from the first to the seventh and then diminish rapidly. The costal cartilages of the uppermost and lowermost ribs are the shortest.

The seven upper ribs which are attached by their cartilages directly to the sternum are termed the *true ribs (costae verae),* in constrast to the five lower ones, the *false ribs (costae spuriae),* which are attached to the sternum only through the intervention of the seventh costal cartilage, or, as in the case of the eleventh and twelfth ribs, have no connection with the other ribs or with each other *(floating ribs).* The cartilages of the sixth (in some cases even of the fifth) to the tenth rib are united with one another by upwardly and downwardly directed processes, termed the *costal arches.* The union may be a synchondrotic one or else diarthrotic. In the region of the costal arches the cartilages are frequently greatly broadened. They always diminish in breadth from their outer ends towards the sternum. Not infrequently the middle ribs especially form what is termed a costal window, by a rib dividing, usually in its bony portion, and then uniting again in the neighbourhood of the cartilage. The eleventh and twelfth ribs have only cartilaginous tips, which are very short and end freely.

The ribs, which form the principal part of the thoracic wall, are so placed that between each two ribs there is an interspace, the *intercostal space,* which is considerably wider than the rib itself. There are eleven of these spaces on each side. The last is very short and, like the next to the last, is open anteriorly.

The first and second costal cartilages slope slightly downwards toward the sternum, the third to the fifth are almost horizontal, while from the sixth downwards the cartilages are directed sharply upwards, especially in expiration, during which a distinct angle is developed at the junction of the bony rib with its cartilage, an angle which is almost completely obliterated during inspiration.

Fig. 35. Thorax (in the inspiration position) with the left shoulder girdle, from behind. ($^{1}/_{3}$)

Fig. 36. Thorax (in the inspiration position) with the left shoulder girdle, from in front. ($^{1}/_{3}$)

The Thorax. *(Cont.)*

Fig. 37. The axial skeleton divided in the median line with the shoulder and pelvic girdles, from the left side. ($^1/_4$)

Fig. 38. The axial skeleton divided in the median line with the shoulder and pelvic girdles, seen from the median line. ($^1/_4$)

The sternum with the costal cartilages and the adjacent portions of the bony ribs form the *anterior wall* of the thorax. It does not lie exactly in the frontal plane, but its upper end is directed somewhat backwards and is therefore somewhat nearer the vertebral column than is the lower part. The greater distance of the lower part from the column is mainly due to the strong concavity of the thoracic portion of the column.

The anterior wall of the thorax is markedly shorter than the posterior, since the upper border of the manubrium sterni corresponds to the interval between the second and third thoracic vertebrae in the neutral position, being lower during expiration and higher in inspiration. The tip of the xiphoid process lies at the level of the ninth thoracic vertebra, or, in accordance with its variable length, occasionally at that of the eighth or tenth.

The posterior wall of the thorax is formed by the twelve thoracic vertebrae and the posterior portions of the twelve pair of ribs. Since the bodies of the former project strongly into the thoracic cavity there is a deep groove on each side of the vertebral column, the *pulmonary groove (sulcus pulmonalis).*

The lateral wall of the thorax is formed by the bony ribs. It is longer posteriorly than in front, where the eleventh and twelfth ribs are lacking, and during expiration reaches, opposite the twelfth rib, the level of the second lumbar vertebra.

The walls of the thorax enclose the *thoracic cavity,* which is almost conical in shape, the apex being directed upwards. This cavity has an *upper* and a *lower aperture,* the upper one being markedly smaller than the lower. It is bounded by the first thoracic vertebra, the first rib and the upper border of the manubrium sterni. The much larger lower aperture is bounded by the twelfth thoracic vertebra, the twelfth, eleventh and tenth ribs, the costal arch and the xiphoid process. The angle that the costal arch forms with the xiphoid process is known as the *infrasternal angle.*

In transverse section the thoracic cavity is heart-shaped on account of the manner in which the bodies of the vertebrae project into it. As a result the sagittal diameter of the thorax is small, much smaller than the transverse, especially in the upper part.

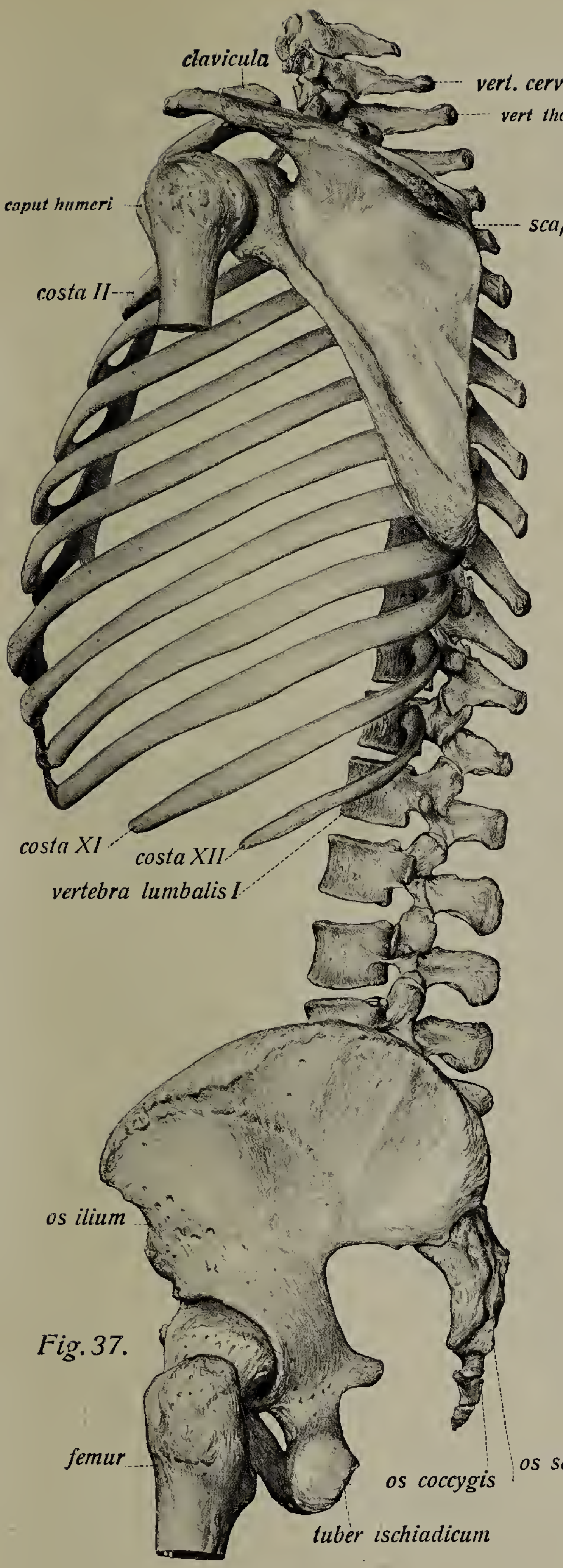
clavicula
vert. cervicalis VII
vert thoracalis I
caput humeri
scapula
costa II
costa XI
costa XII
vertebra lumbalis I
os ilium
femur
os coccygis
os sacrum
tuber ischiadicum

Fig. 37.

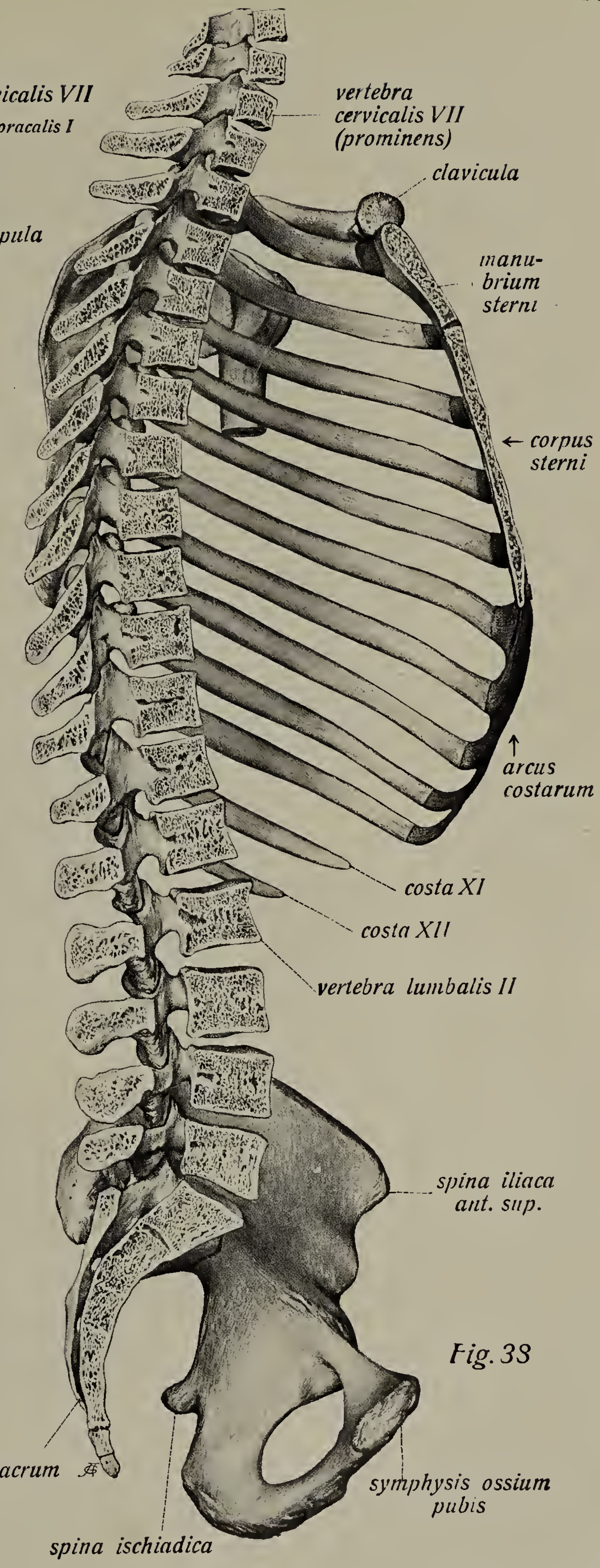
vertebra cervicalis VII (prominens)
clavicula
manubrium sterni
corpus sterni
arcus costarum
costa XI
costa XII
vertebra lumbalis II
spina iliaca ant. sup.
symphysis ossium pubis
spina ischiadica

Fig. 38

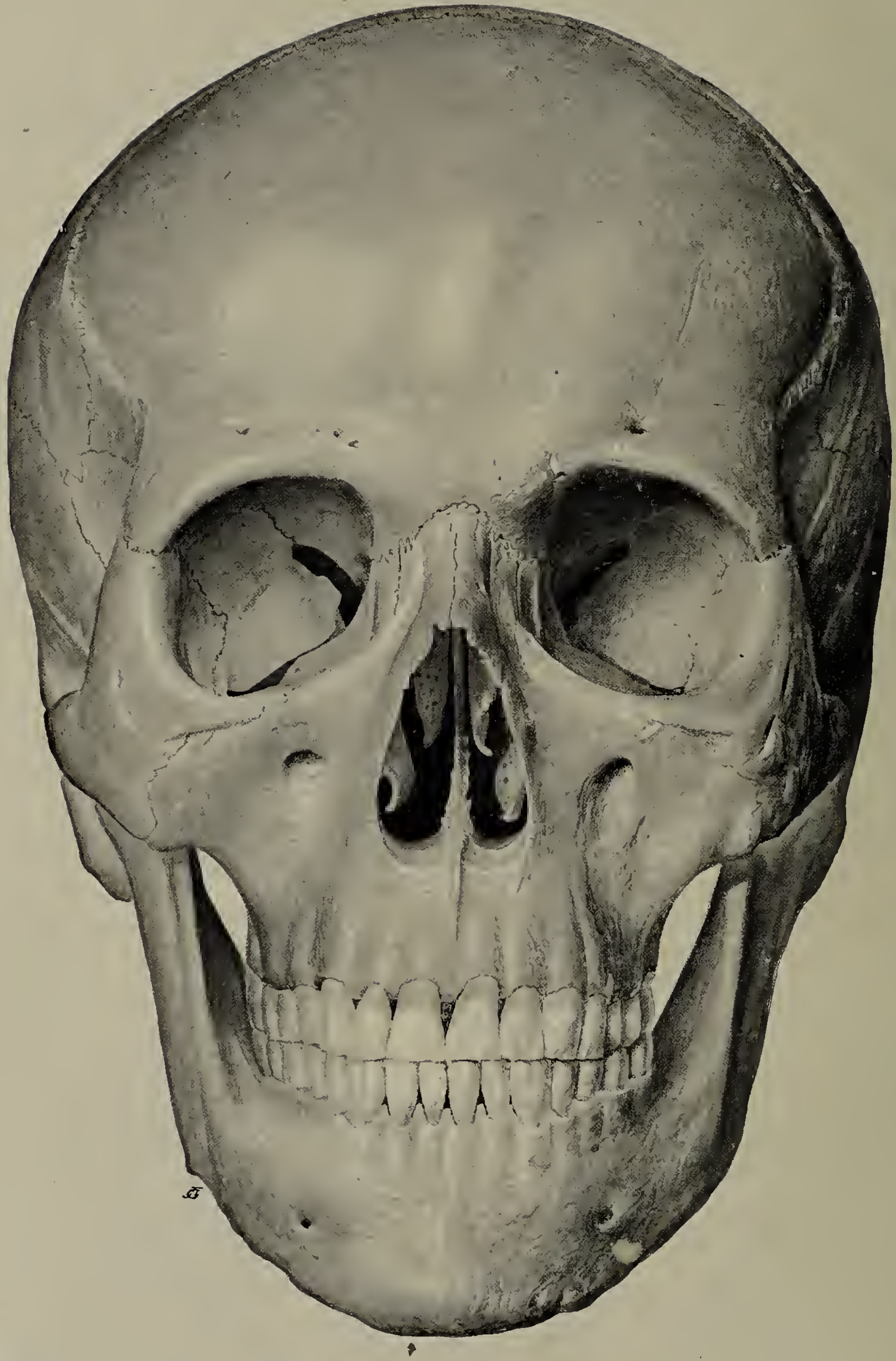

Fig. 39.

B. The Skull and Skull Bones.

The Skull as a whole.

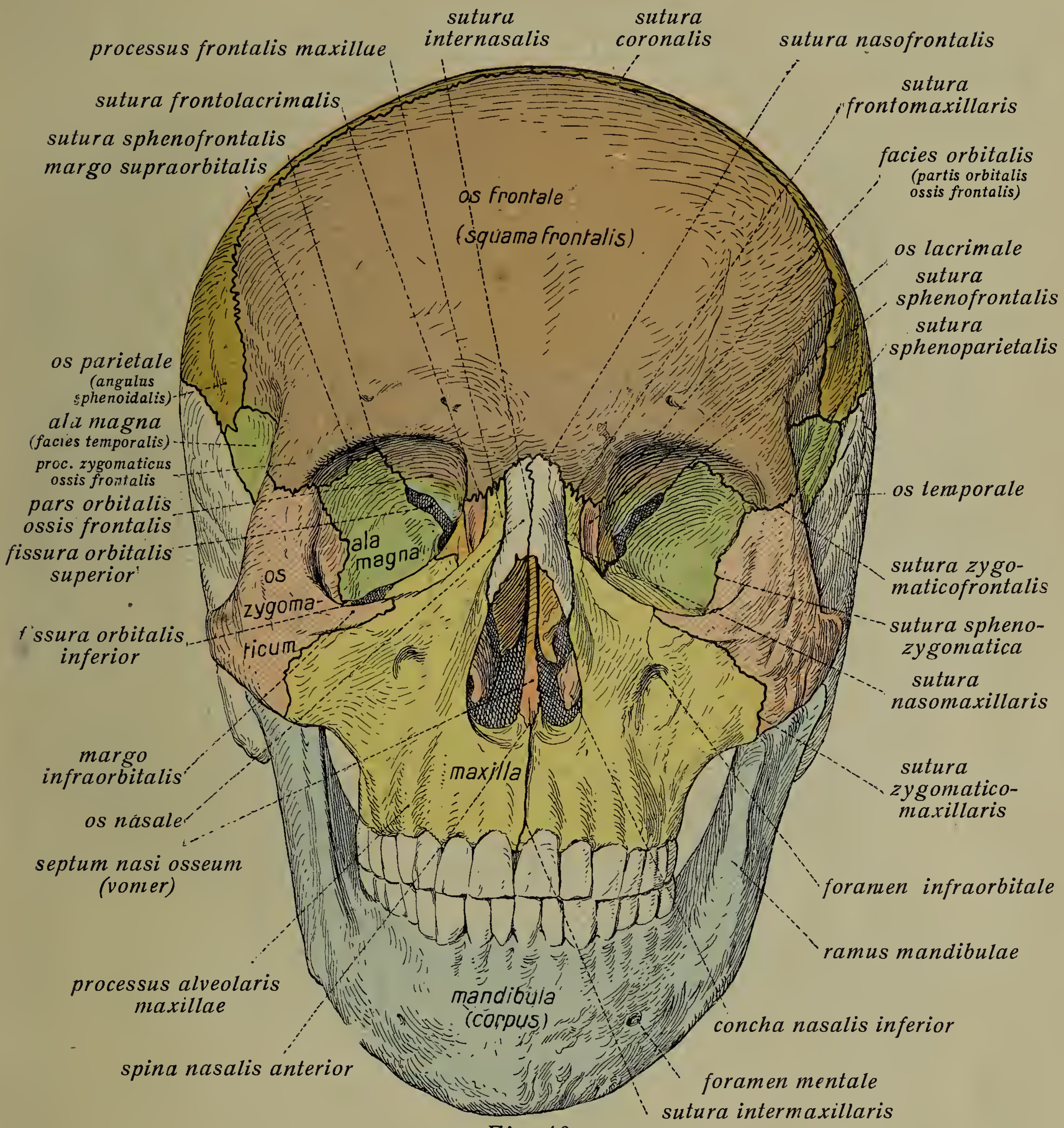

Fig. 40.

Figs. 39 and 40. The skull from in front ($^4/_5$)

In Fig. 40 the frontal bone is violet, maxilla yellow, sphenoid green, parietal brown, lacrimal and vomer red, ethmoid orange, zygomatic red streaked, mandible blue streaked, nasal and temporal white.

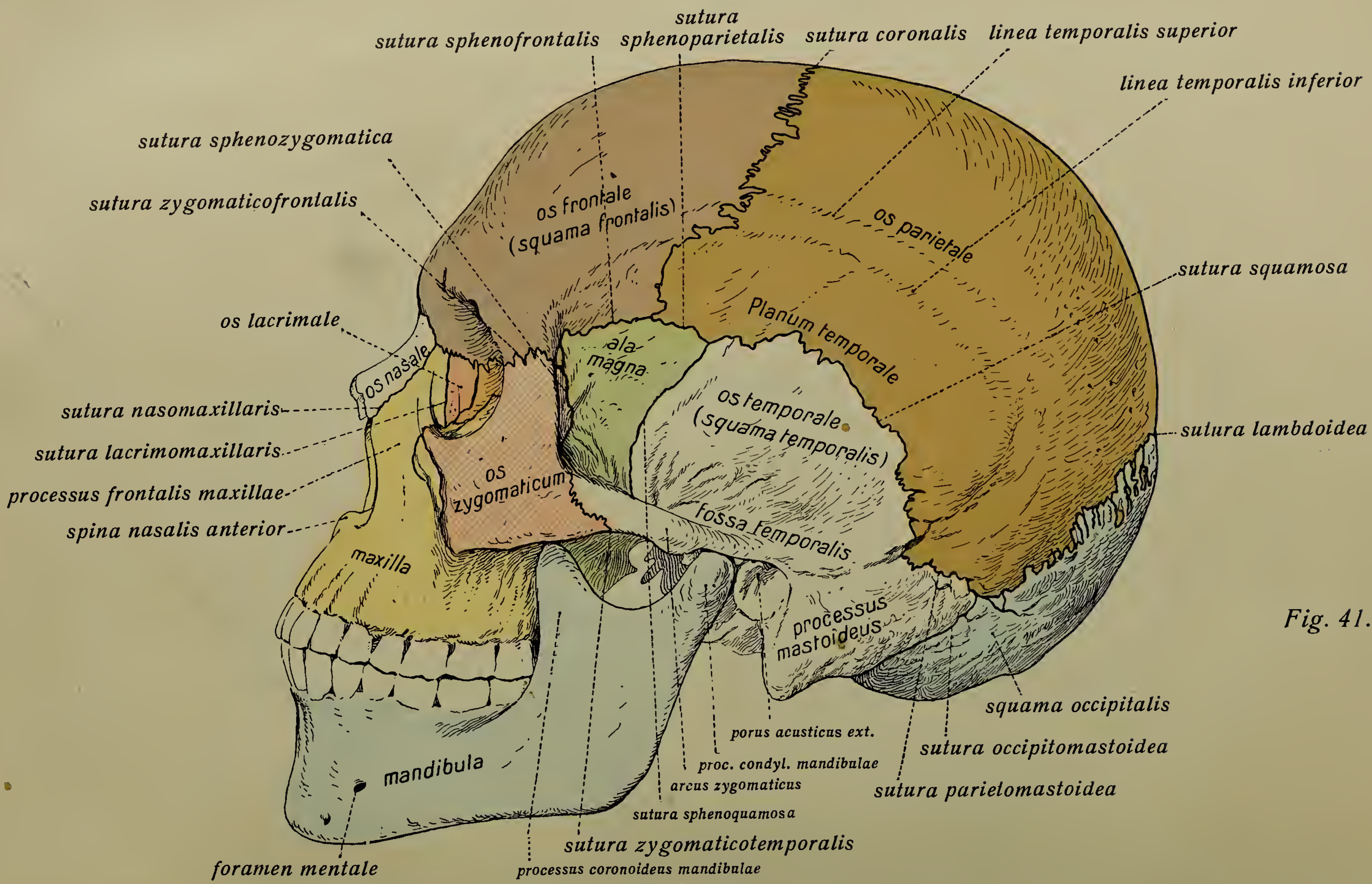

Fig. 41.

Figs. 41 and 42. The skull from the left side. ($^4/_5$)

In Fig. 41 the frontal bone is violet, maxilla yellow, parietal brown, sphenoid green, lacrimal red, ethmoid orange, occipital blue, zygomatic red streaked, mandible blue streaked, temporal and nasal white.

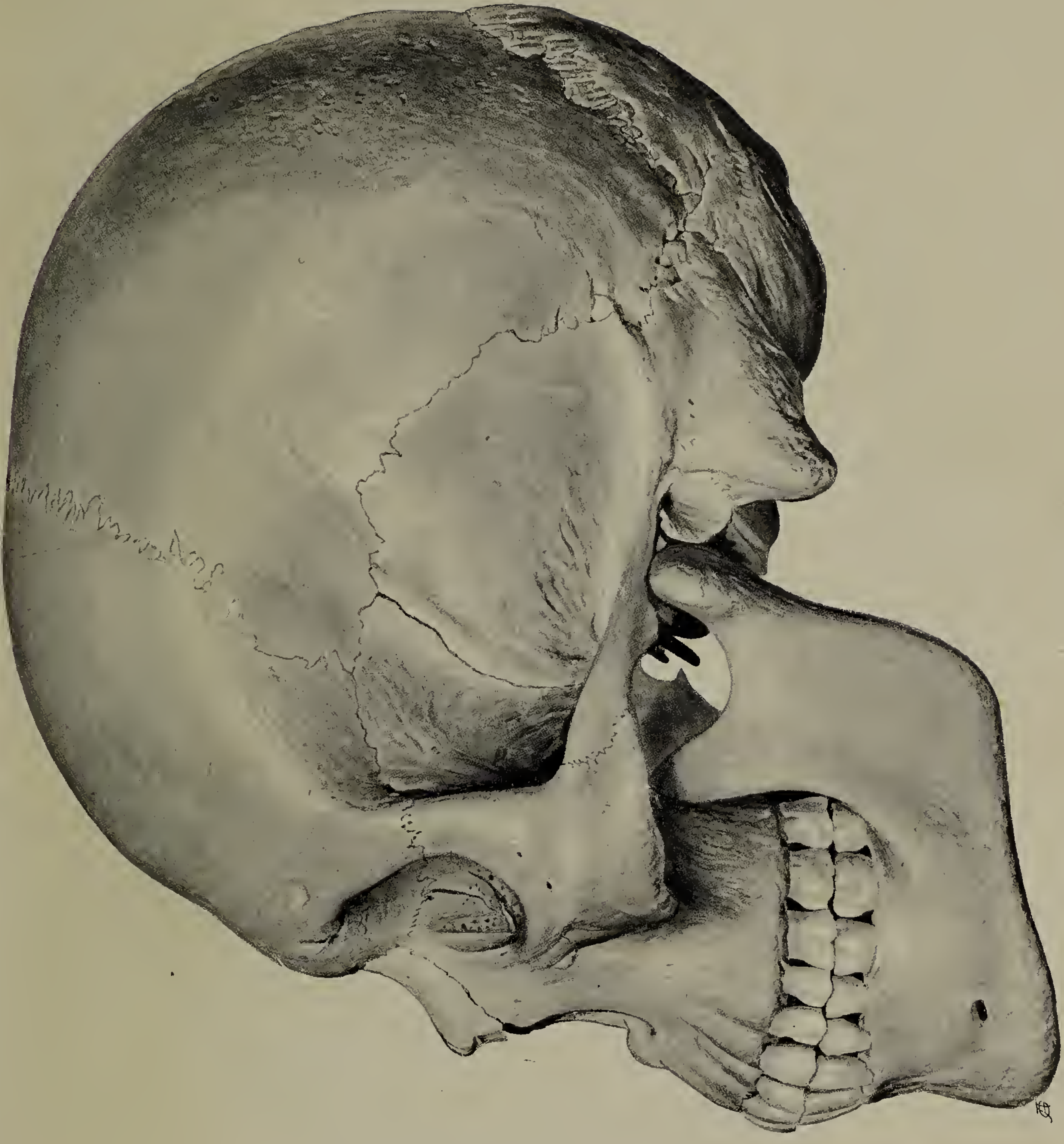

Fig. 42.

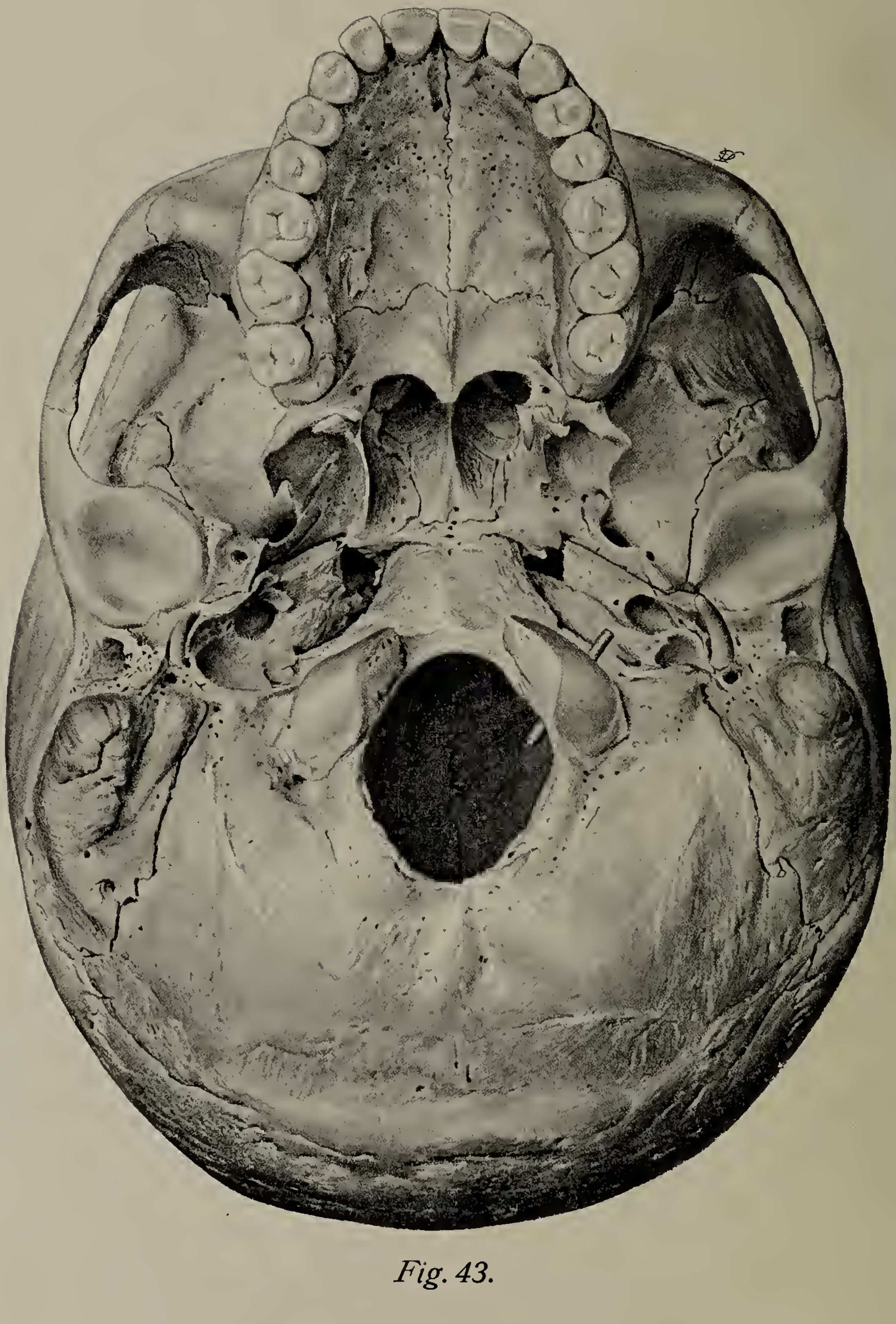

Fig. 43.

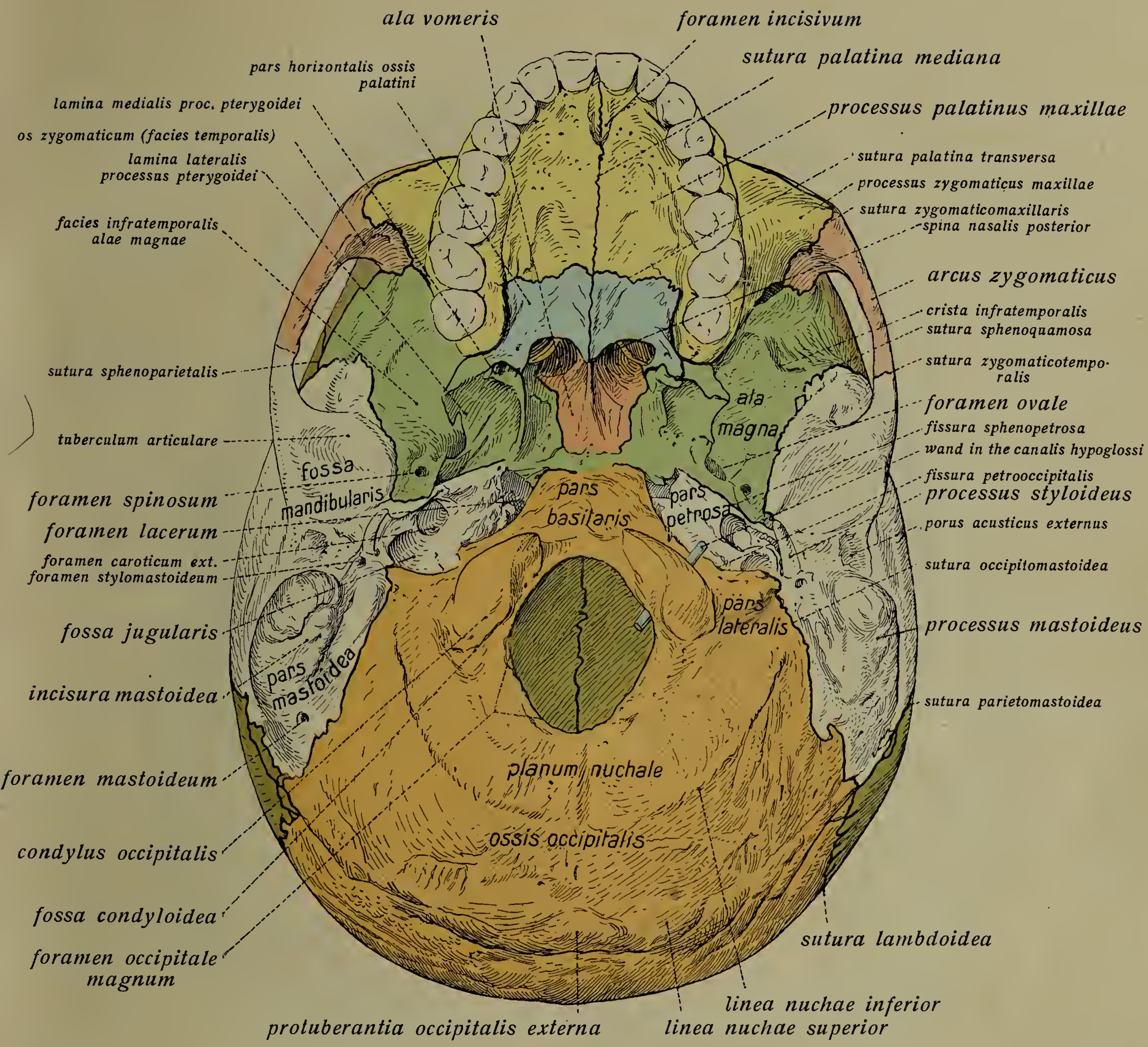

Fig. 44.

Figs. 43 and 44. The skull from below *(basis cranii)*. ($^4/_5$)

In Fig. 44 the maxilla is yellow, palatine blue, frontal violet, sphenoid green, temporal white, zygomatic red streaked, vomer red, occipital orange streaked, parietal brown, ethmoid orange.

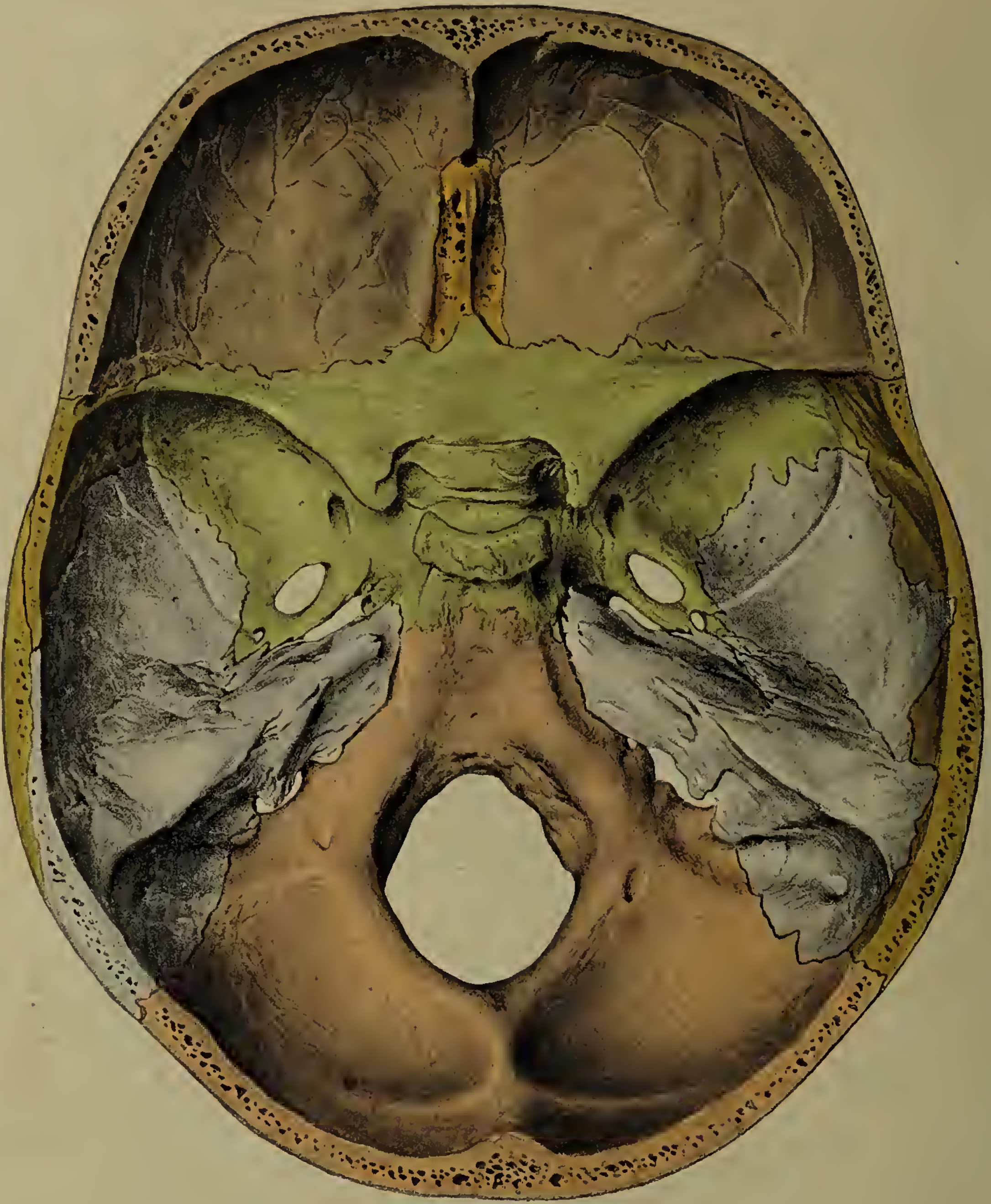

Fig. 45.

Figs. 45 and 46. The base of the skull from within. (Fig. 45, $^4/_5$; Fig. 46, $^1/_1$).

In Fig. 45 the frontal bone is violet, ethmoid orange, sphenoid green, parietal brown, temporal white, occipital red.

In Fig. 46 behind the foramen lacerum there is a distinct but unlabelled impression for the trigeminal nerve at the apex of the pyramid. It is stronger on the left side than on the right.

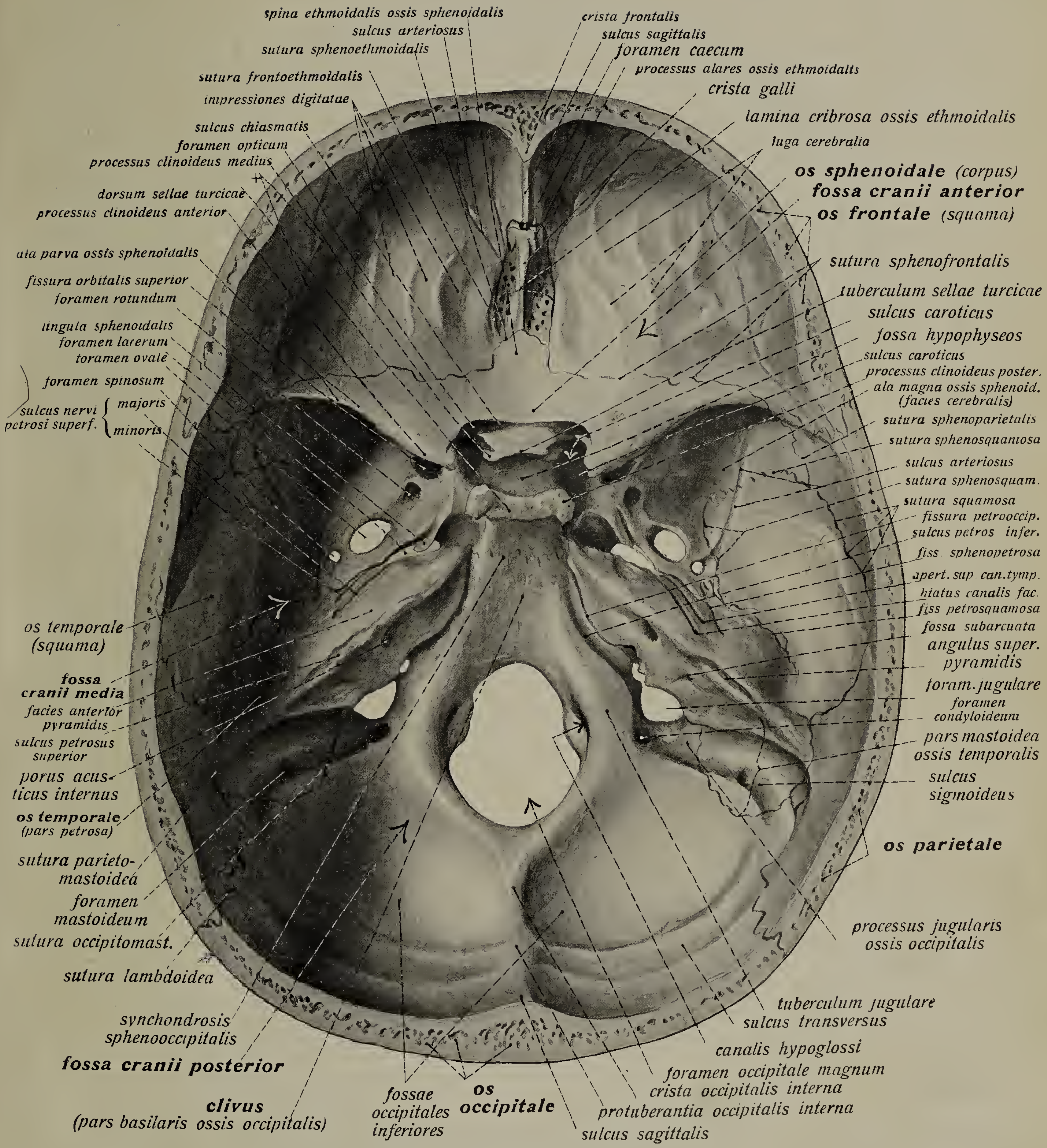
spina ethmoidalis ossis sphenoidalis
sulcus arteriosus
sutura sphenoethmoidalis
sutura frontoethmoidalis
impressiones digitatae
sulcus chiasmatis
foramen opticum
processus clinoideus medius
dorsum sellae turcicae
processus clinoideus anterior
ala parva ossis sphenoidalis
fissura orbitalis superior
foramen rotundum
lingula sphenoidalis
foramen lacerum
foramen ovale
foramen spinosum
sulcus nervi petrosi superf. majoris
minoris
os temporale (squama)
fossa cranii media
facies anterior pyramidis
sulcus petrosus superior
porus acusticus internus
os temporale (pars petrosa)
sutura parieto-mastoidea
foramen mastoideum
sutura occipitomast.
sutura lambdoidea
synchondrosis sphenooccipitalis
fossa cranii posterior
clivus
(pars basilaris ossis occipitalis)
fossae occipitales inferiores
os occipitale
sulcus sagittalis
protuberantia occipitalis interna
crista occipitalis interna
foramen occipitale magnum
canalis hypoglossi
sulcus transversus
tuberculum jugulare
processus jugularis ossis occipitalis
os parietale
sulcus sigmoideus
pars mastoidea ossis temporalis
foramen condyloideum
foram. jugulare
angulus super. pyramidis
fossa subarcuata
fiss petrosquamosa
hiatus canalis fac.
apert. sup. can. tymp.
fiss. sphenopetrosa
sulcus petros infer.
fissura petrooccip.
sutura squamosa
sutura sphenosquam.
sulcus arteriosus
sutura sphenosquamosa
sutura sphenoparietalis
ala magna ossis sphenoid. (facies cerebralis)
processus clinoideus poster.
sulcus caroticus
fossa hypophyseos
sulcus caroticus
tuberculum sellae turcicae
sutura sphenofrontalis
os frontale (squama)
fossa cranii anterior
os sphenoidale (corpus)
iuga cerebralia
lamina cribrosa ossis ethmoidalis
crista galli
processus alares ossis ethmoidalis
foramen caecum
sulcus sagittalis
crista frontalis

Fig. 46.

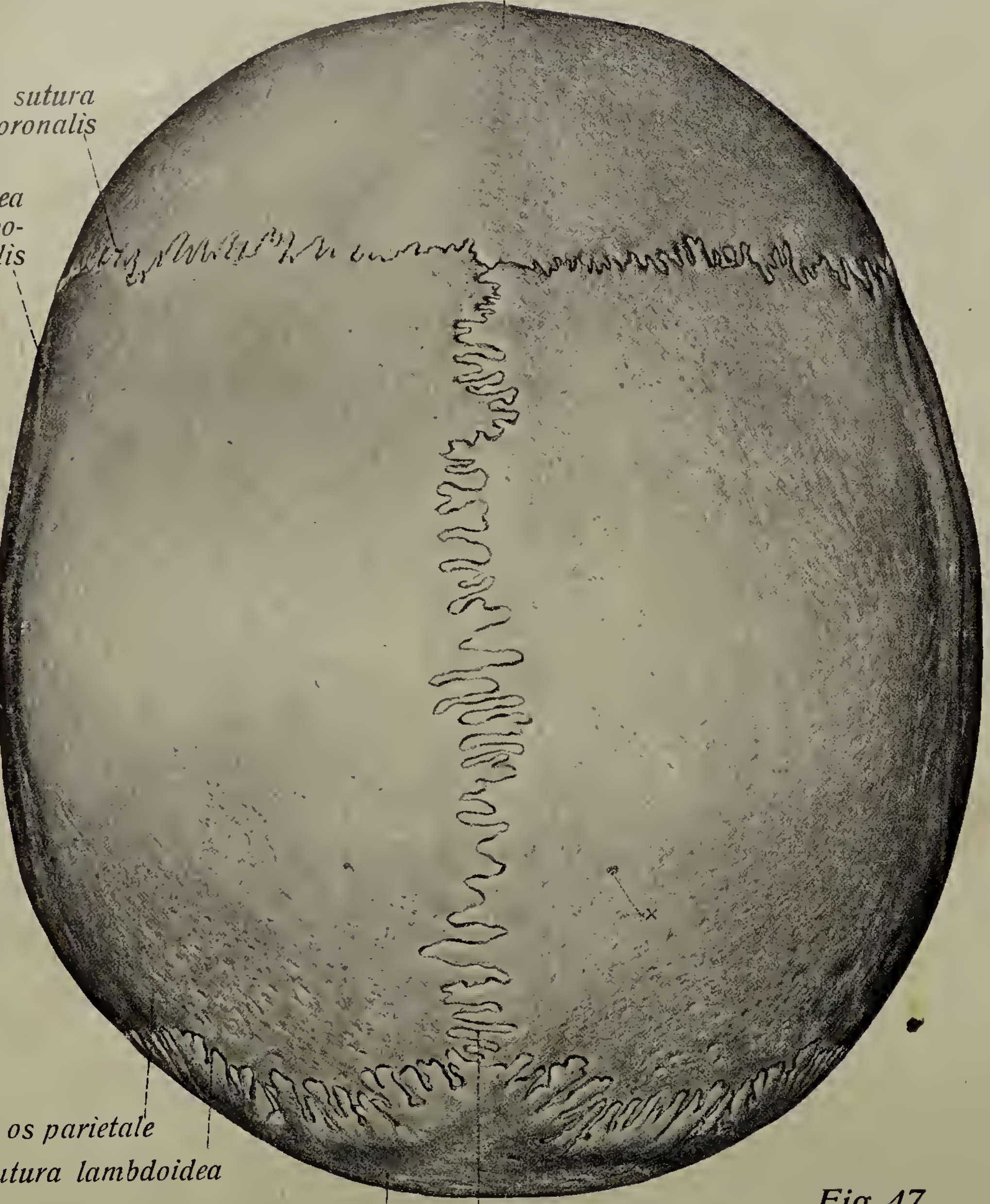
os frontale
sutura coronalis
linea temporalis
os parietale
sutura lambdoidea
squama occipitalis
sutura sagittalis

Fig. 47.

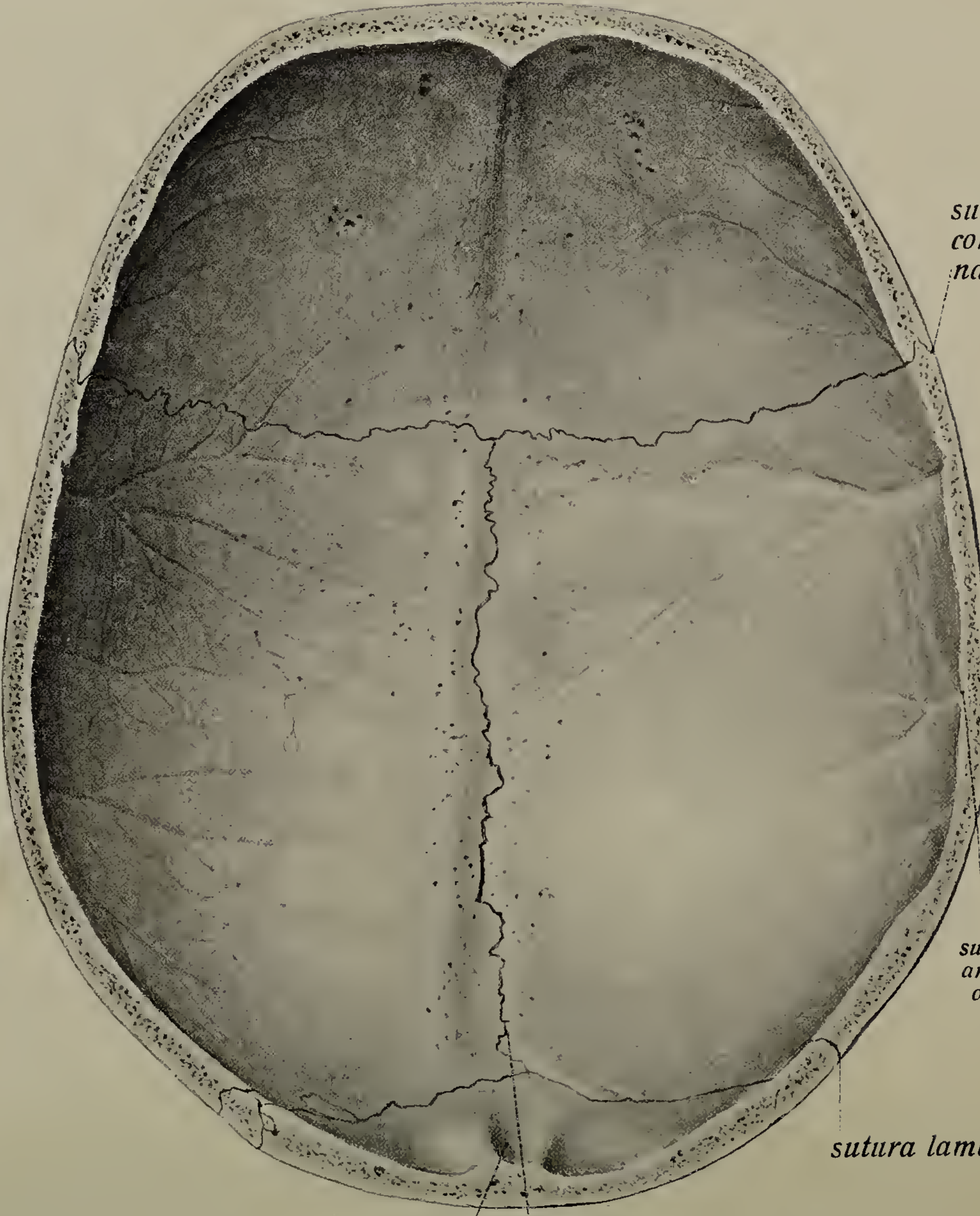
sutura coronalis
sulcus arteriosus
sutura lambdoidea
sulcus sagittalis
sutura sagittalis

Fig. 48.

Fig. 47. The skull seen from above. ($^{4}/_{5}$) x = parietal foramen.
Fig. 48. The skull cap *(calvarium)* from within. ($^{4}/_{5}$)

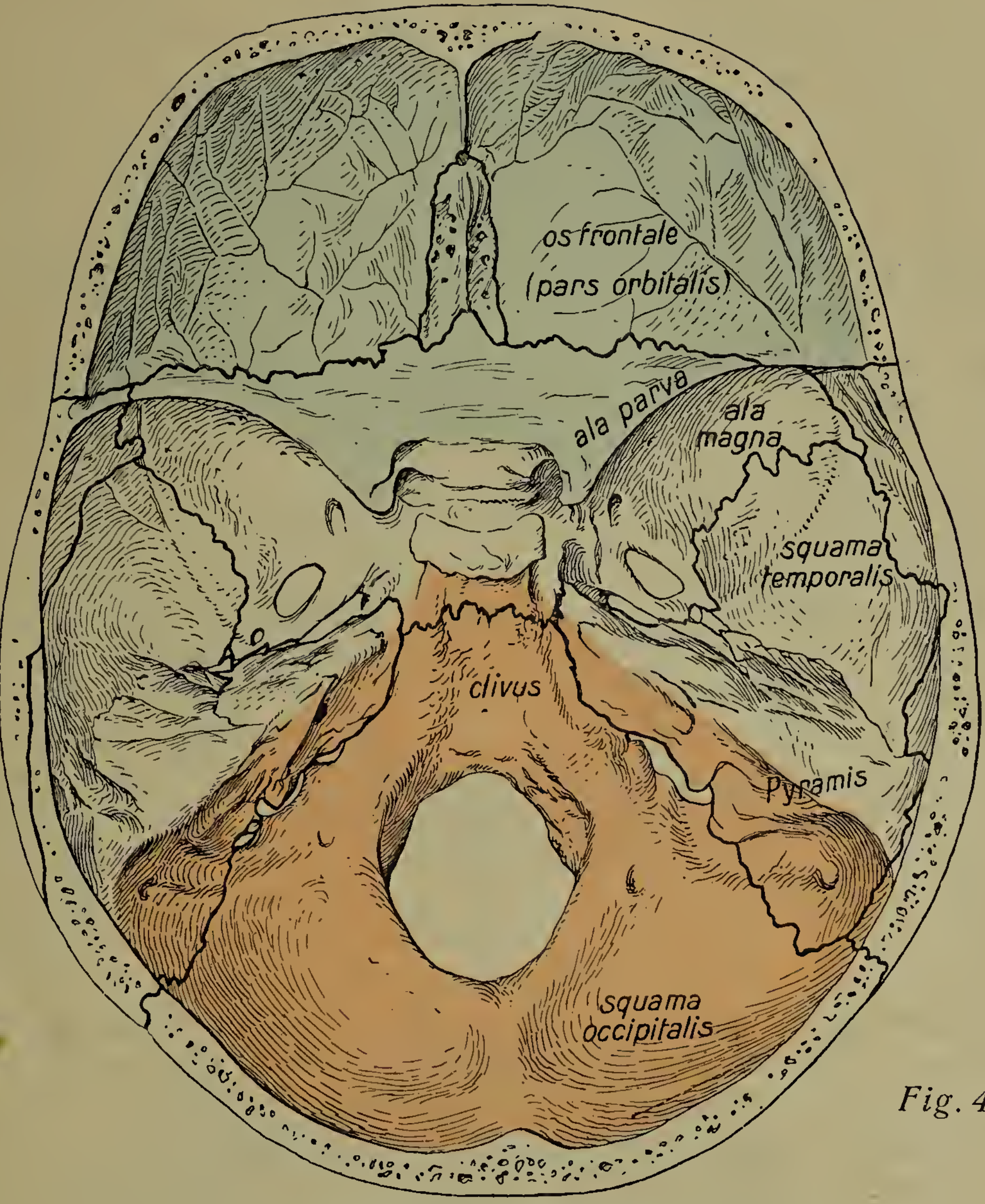

Fig. 49.

Fig. 49. Inner surface of the base of the skull. The anterior fossa is blue, the middle white and the posterior red.

The bones of the head taken together form what is termed the skull *(cranium)*. Two groups of skull bones are usually recognized, the *bones of the cranium* and the *bones of the face*. To the former belong the occipital, the sphenoid, the temporals, the parietals, the frontal and the ethmoid.

The bones of the face are the nasals, the lacrimals, the vomer, the inferior concha, the maxillae, the palatines, the zygomatics, the mandible and the hyoid.

The Occipital Bone.

Fig. 50. The occipital bone from behind ($^4/_5$).
Fig. 51. The occipital bone from in front ($^4/_5$).

The bone is represented as separated by a saw-cut (x) from the sphenoid at the level of the ossified sphenooccipital synchondrosis. A probe is placed in the hypoglossal canal.

In the *occipital* bone the following parts may be distinguished: 1. the *basilar portion,* 2. the *lateral (condylar) portions* and 3. the *squamous portion.* The basilar portion lies in front of the *foramen magnum,* the lateral portions form the lateral boundaries of this and the squamous portion lies behind it.

The *basilar portion* in the skull of the adult is continuous at its anterior end with the body of the sphenoid. It presents a horizontal, roughened, lower surface, which has in the median line a tubercle, the *pharyngeal tubercle.* Its upper or cerebral surface is concave. This latter surface forms the largest and posterior part of the *clivus* and shows a shallow groove at the margin of the petro-occipital fissure, the *inferior petrosal groove.*

The *lateral portions* bear upon their under surfaces the elongated, convex *occipital condyles* and pass without any sharp boundary into the basilar portion anteriorly and the squamous portion posteriorly. Behind the condyles is a shallow depression, the *condyloid fossa,* in which a short *condyloid canal* usually opens. When this canal is present its inner opening is on or near a broad groove, the *sigmoid sulcus.* This arches on the cerebral surface of the lateral portion around the *jugular process,* beginning at the *jugular notch,* which, together with a similar notch on the temporal bone forms the *jugular foramen.* A small projection *(intrajugular process)* on each of these two bones divides the foramen into a small anterior (medial) and a larger posterior (lateral) portion (Fig. 46). The jugular process projects strongly laterally and serves for the articulation of the lateral portion of the occipital with the pyramid of the temporal bone. Medial to the jugular process there is on the cerebral surface of the lateral portion a rounded elevation, the *jugular tubercle.* Between this and the condyle there passes almost transversely through the bone the *hypoglossal canal* for the nerve of that name.

The *squamous portion* is by far the largest portion of the occipital bone. It is rather flat but is curved like a shovel, being concave on the inner surface and convex on the outer. It is typically triangular. Along the occipito-mastoid suture it articulates with the mastoid portion of the temporal bone and at the lambdoid suture with the two parietal bones. The upper angle abuts in the middle of the lambdoid suture upon the posterior end of the sagittal suture. Its cerebral surface presents a cross-like figure, whose upper and lateral arms are formed by grooves, while the lower arm is formed by a ridge, the *internal occipital crest,* which passes toward the posterior border of the foramen magnum. The groove forming the upper arm of the cross is the lower portion of the *sagittal sulcus,* while the transverse grooves are the *transverse sulci;* the similarly named blood sinuses of the dura mater occupy these sulci. The central point of the cross-like figure is the *internal occipital protuberance.* The arms of the cross-like figure separate two shallow *superior occipital fossae* from one another and from two deeper *inferior occipital fossae.*

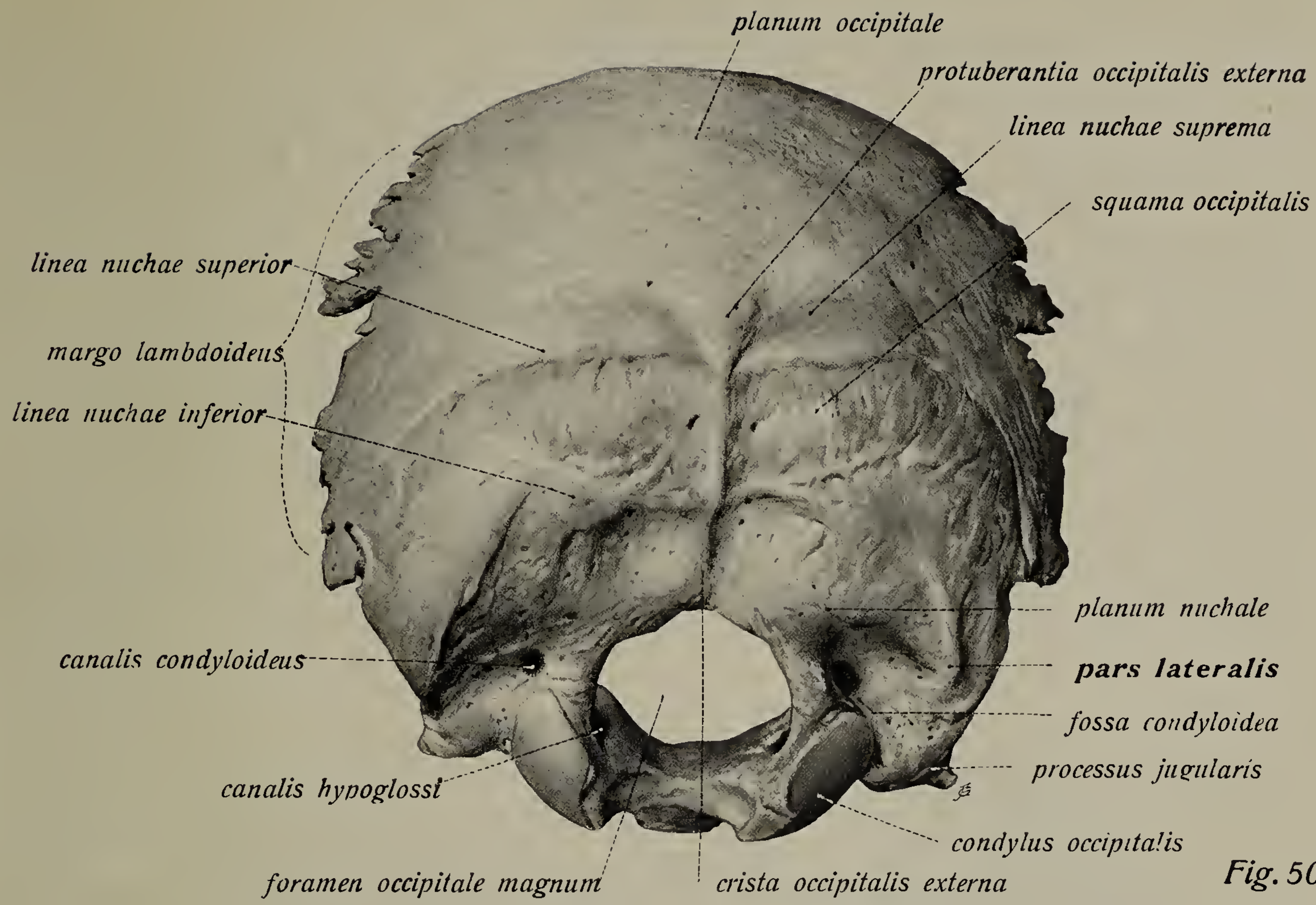
planum occipitale
protuberantia occipitalis externa
linea nuchae suprema
squama occipitalis
linea nuchae superior
margo lambdoideus
linea nuchae inferior
planum nuchale
pars lateralis
canalis condyloideus
fossa condyloidea
processus jugularis
canalis hypoglossi
condylus occipitalis
foramen occipitale magnum
crista occipitalis externa

Fig. 50.

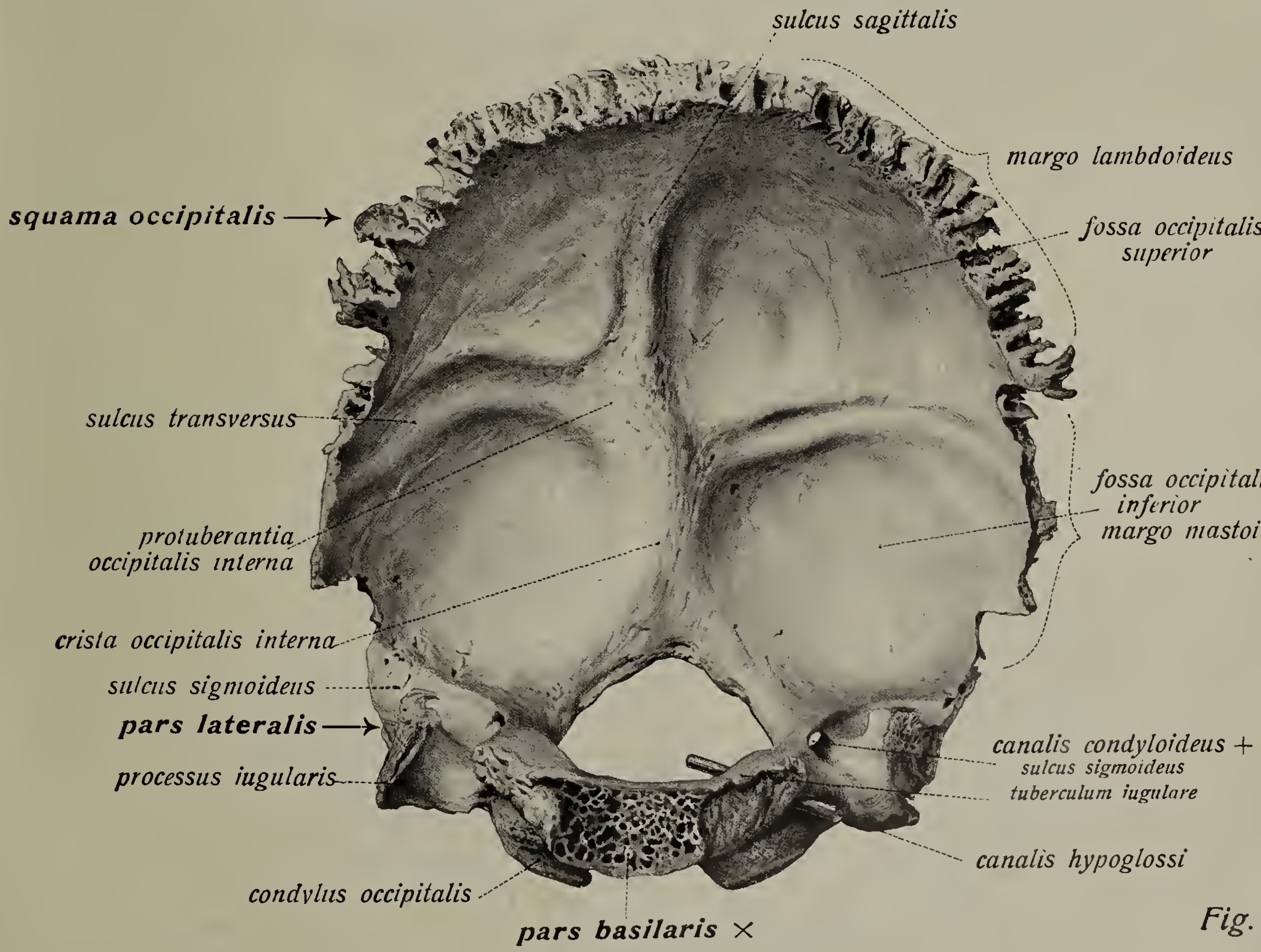
sulcus sagittalis
margo lambdoideus
squama occipitalis →
fossa occipitalis superior
sulcus transversus
fossa occipitalis inferior
margo mastoideus
protuberantia occipitalis interna
crista occipitalis interna
sulcus sigmoideus
pars lateralis →
canalis condyloideus + sulcus sigmoideus
processus iugularis
tuberculum iugulare
canalis hypoglossi
condylus occipitalis
pars basilaris ×

Fig. 51.

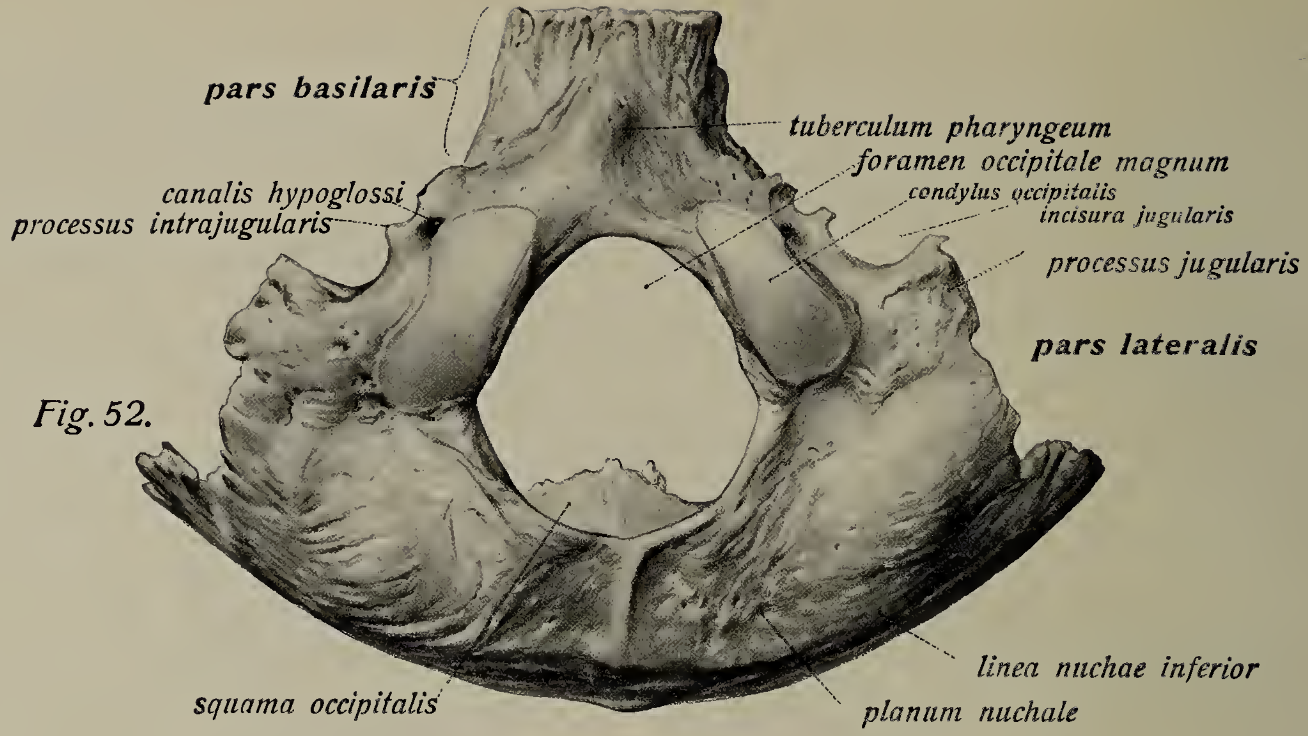
pars basilaris
tuberculum pharyngeum
foramen occipitale magnum
canalis hypoglossi
processus intrajugularis
condylus occipitalis
incisura jugularis
processus jugularis
pars lateralis
linea nuchae inferior
planum nuchale
squama occipitalis

Fig. 52.

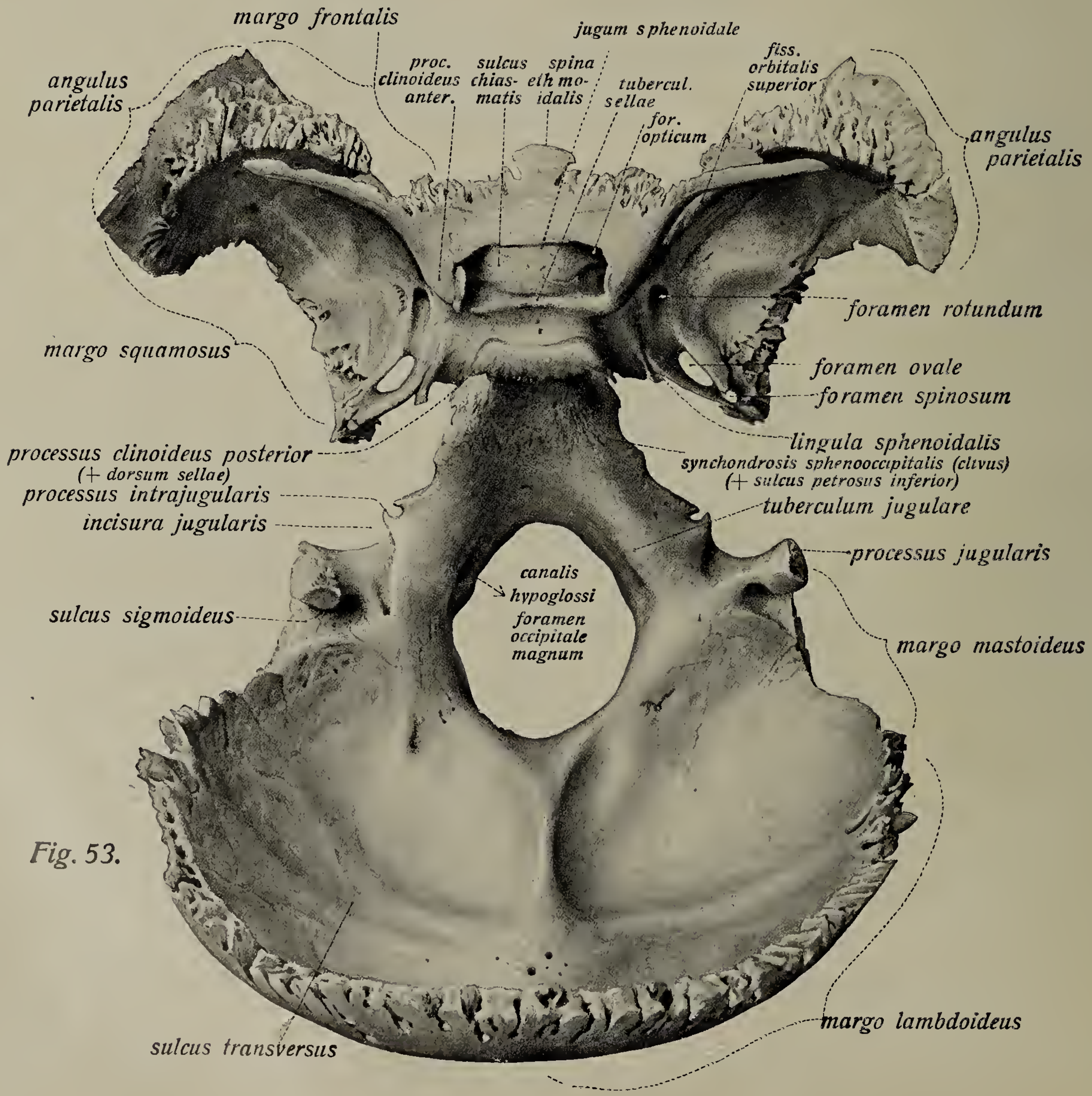
margo frontalis
jugum sphenoidale
angulus parietalis
proc. clinoideus anter.
sulcus chiasmatis
spina ethmoidalis
tubercul. sellae
for. opticum
fiss. orbitalis superior
angulus parietalis
foramen rotundum
margo squamosus
foramen ovale
foramen spinosum
lingula sphenoidalis
processus clinoideus posterior
(+ dorsum sellae)
synchondrosis sphenooccipitalis (clivus)
(+ sulcus petrosus inferior)
processus intrajugularis
incisura jugularis
tuberculum jugulare
processus jugularis
canalis
hypoglossi
foramen
occipitale
magnum
sulcus sigmoideus
margo mastoideus
margo lambdoideus
sulcus transversus

Fig. 53.

The Occipital Bone (Cont.) and the Sphenoid Bone.

Fig. 52. The occipital bone from below. ($^4/_5$)
Fig. 53. The occipital and sphenoid bones seen from above. ($^4/_5$)

In Fig. 53 the right anterior clinoid process is united with the middle process; the dorsum sellæ which passes laterally into the posterior clinoid processes, the carotid groove which lies between these processes and the sphenoidal lingula and the hypophyseal fossa between the tuberculum and dorsum sellæ are not labelled.

The outer surface of the squamous portion of the occipital is divided into two parts by the *superior nuchal lines,* which pass laterally from the *external occipital protuberance.* The upper, triangular, relatively smooth part is the *occipital surface,* the lower rough part the *nuchal surface.* Above the superior nuchal lines there are usually two arched *supreme nuchal lines.* From the external occipital protuberance the *external occipital crest* extends downwards toward the posterior border of the foramen magnum, and from about its middle the *inferior nuchal lines* curve outwards, parallel to the superior ones.

The Sphenoid Bone.

The *sphenoid* bone has a *body (corpus),* two *great wings (alae magnae),* two *lesser wings (alae parvae)* and two *pterygoid processes.*

The *body (corpus)* unites in later life by its posterior surface with the basilar portion of the occipital. It contains a cavity filled with air, the *sphenoidal sinus,* which is divided into two parts by a septum and communicates by two apertures with the posterior part of the nasal cavity. The septum shows itself on the anterior surface of the body as the *sphenoidal crest.* The anterior wall is formed by two thin bony plates, the *sphenoidal conchae,* which originally belong to and are often united with the ethmoid bone. The sphenoidal crest is continued upon the under surface of the body as the *rostrum* and serves for articulation with the wings of the vomer. The upper surface of the body is partly formed by the *sella turcica,* in front of which is a flat surface, which posteriorly bounds the sulcus chiasmatis of the sella turcica and anteriorly projects towards the lamina cribrosa as the *ethmoidal spine.* The posterior boundary of the sella turcica is the *dorsum sellae* with the two *posterior clinoid processes* at its outer ends; in front of it is the deepest part of the sella, the *hypophyseal fossa,* which is bounded in front by the *tuberculum sellae* (Fig. 46). In front of the tuberculum sellae there is a shallow, transverse groove, the *sulcus chiasmatis.* From the lateral parts of the tuberculum sellae the short *middle clinoid processes* project. At the sides of the hypophyseal fossa and on the root of the great wing there is a shallow, but broad, longitudinal groove, the *carotid groove,* for the internal carotid artery. It is bounded laterally by a small bony plate, the *sphenoidal lingula.* (Fig. 46.) The anterior part of the *clivus,* behind the dorsum sellae belongs to the sphenoid bone.

The *lesser wings (alae parvae)* are small plates of bone which arise from the lateral surfaces of the body of the sphenoid, each by two roots which enclose the optic foramen. Their anterior border articulates with the orbital portion of the frontal bone in the spheno-frontal suture; their posterior border forms a boundary for the anterior and middle cranial fossae and ends medially, toward the sella turcica, in a sharp point, the *anterior clinoid process.* The lesser and greater wings are completely separated by the *superior orbital fissure.*

The Sphenoid Bone. (Cont.)

Fig. 55. The sphenoid bone from in front. ($^1/_1$)
+ = the position of the pharyngeal canal; ++ = processus vaginalis.
Fig. 56. The sphenoid from behind. ($^1/_1$)

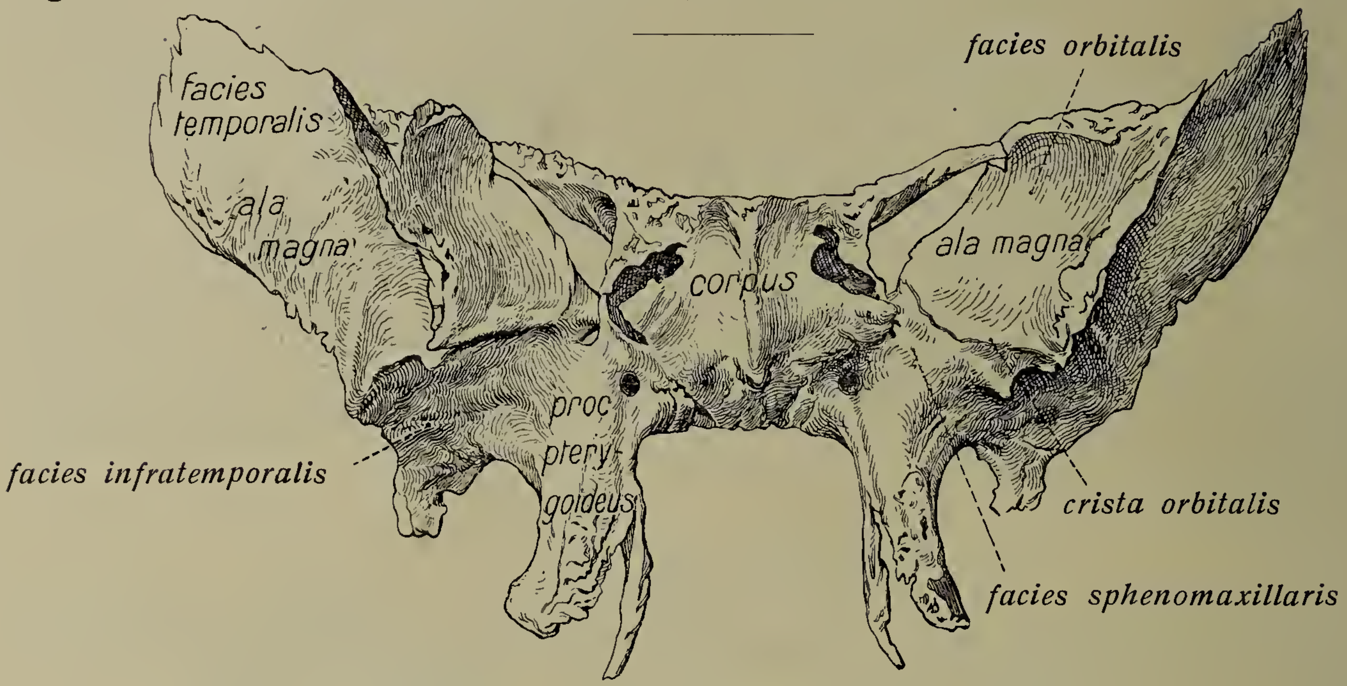

Fig. 54. A view of the sphenoid from in front.

The *great wing (ala magna)* arises from the lateral surface of the body of the sphenoid. In its root there are three foramina the *foramen rotundum* directed obliquely forward and leading into the pterygo-palatine fossa, the *foramen ovale* also placed obliquely and the small, round *foramen spinosum*. The great wing has three principal surfaces, *cerebral*, *temporal* and *orbital*, and the following borders, a *squamous border (margo squamosus)* for the squamous portion of the temporal, a *frontal border (margo frontalis)* for the orbital portion of the frontal, a *zygomatic border (margo zygomaticus)* for the zygomatic and a *parietal angle* for the parietal. The lateral posterior process which bears the external opening of the foramen spinosum and is directed toward the under surface of the pyramid of the temporal bone is termed the *spine of the sphenoid (spina angularis)*. The cerebral surface is concave and, in addition to the three foramina, shows *digitate impressions*. The orbital surface is almost flat and forms a part of the lateral wall of the orbit. A sharp *orbital crest* separates it from the small *spheno-maxillary surface*. Similarly the temporal surface is divided by the *infratemporal crest* into the upper *temporal* and the lower *infratemporal surfaces*, the latter, again, passing into the spheno-maxillary surface, there being frequently between the two a *spheno-maxillary crest*. The infratemporal surface bears the external openings of the foramen ovale and foramen spinosum, the spheno-maxillary surface that of the foramen rotundum.

The *pterygoid processes* extend almost vertically downwards, almost parallel with one another, from the under surface of the body of the sphenoid; they arise on each side by two roots which enclose between them the *pterygoid* (Vidian) *canal*, which is directed almost horizontally in the sagittal plane. It unites the foramen lacerum with the pterygo-palatine fossa. Below, the pterygoid processes divide into a smaller *inner* and a broader *outer plate (lamina)* separated in their upper part by a groove, the *pterygoid fossa*, in their lower part by a cleft, the pterygoid *fissure*, which is filled by the pyramidal process of the palatine bone. The inner plate has at its base an elongated depression, the *scaphoid fossa*, and at its lower end and separated from it by a groove, the *hamulus*. A small process projecting toward the body of the sphenoid, the *processus vaginalis*, encloses the *pharyngeal canal* by uniting with a process of the palatine bone. From the scaphoid fossa a shallow groove, *sulcus tubae auditivae* extends toward the spinous process along the spheno-petrous suture. On the anterior surface of the pterygoid process is a groove, the *pterygo-palatine groove*, extending downwards from the anterior opening of the pterygoid canal. It forms with the corresponding grooves on the palatine bone and maxilla the *pterygo-palatine canal*.

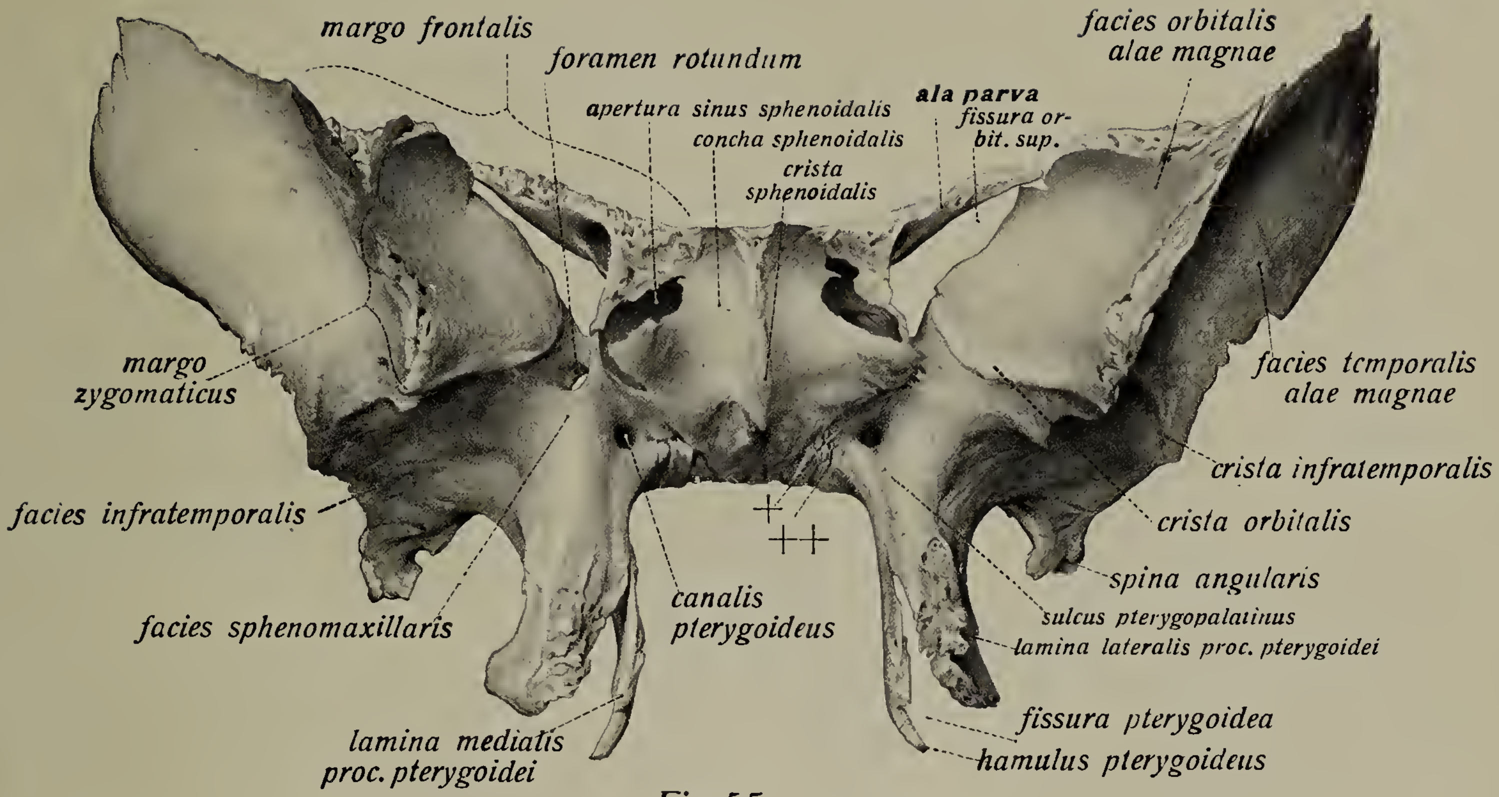
margo frontalis
foramen rotundum
apertura sinus sphenoidalis
concha sphenoidalis
crista sphenoidalis
ala parva
fissura orbit. sup.
facies orbitalis alae magnae
margo zygomaticus
facies temporalis alae magnae
crista infratemporalis
facies infratemporalis
crista orbitalis
+
++
spina angularis
facies sphenomaxillaris
canalis pterygoideus
sulcus pterygopalatinus
lamina lateralis proc. pterygoidei
fissura pterygoidea
lamina medialis proc. pterygoidei
hamulus pterygoideus

Fig. 55.

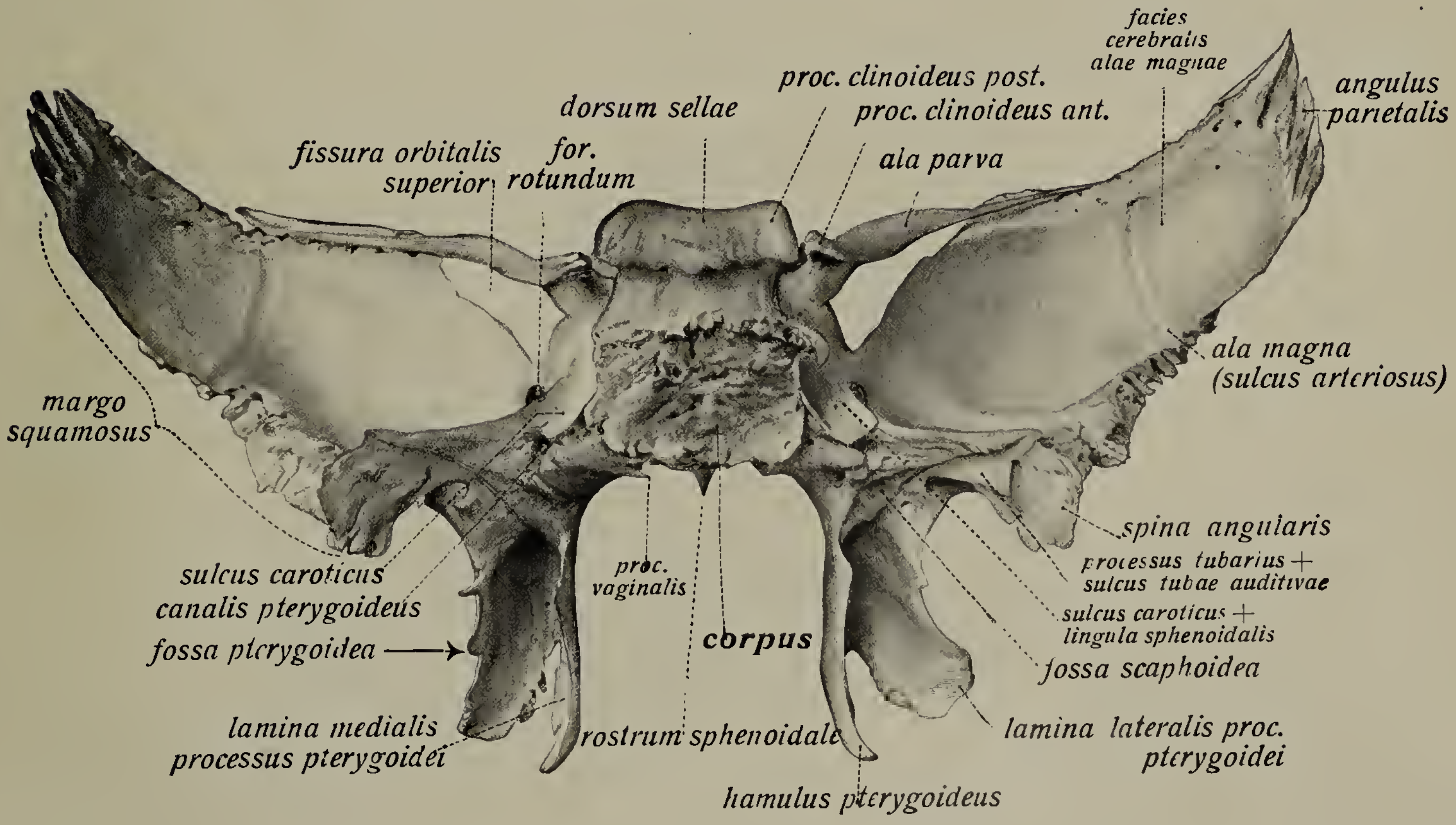
facies cerebralis alae magnae
angulus parietalis
proc. clinoideus post.
dorsum sellae
proc. clinoideus ant.
fissura orbitalis superior
for. rotundum
ala parva
ala magna (sulcus arteriosus)
margo squamosus
spina angularis
processus tubarius +
sulcus tubae auditivae
sulcus caroticus
canalis pterygoideus
proc. vaginalis
sulcus caroticus +
lingula sphenoidalis
fossa pterygoidea
corpus
fossa scaphoidea
lamina medialis processus pterygoidei
rostrum sphenoidale
lamina lateralis proc. pterygoidei
hamulus pterygoideus

Fig. 56.

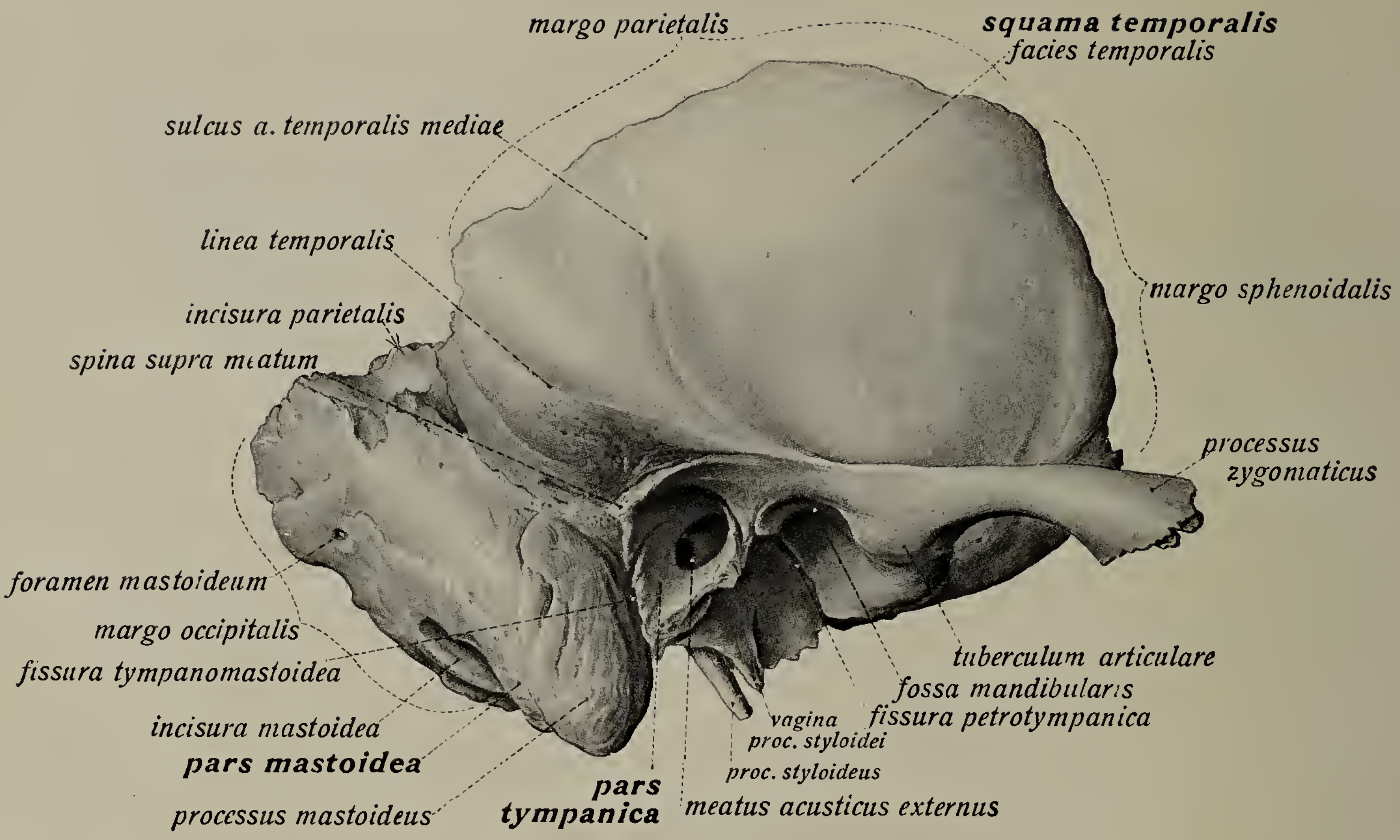
margo parietalis
squama temporalis
facies temporalis
sulcus a. temporalis mediae
linea temporalis
margo sphenoidalis
incisura parietalis
spina supra meatum
processus zygomaticus
foramen mastoideum
margo occipitalis
fissura tympanomastoidea
tuberculum articulare
fossa mandibularis
incisura mastoidea
vagina proc. styloidei
fissura petrotympanica
pars mastoidea
proc. styloideus
pars tympanica
processus mastoideus
meatus acusticus externus

Fig. 57.

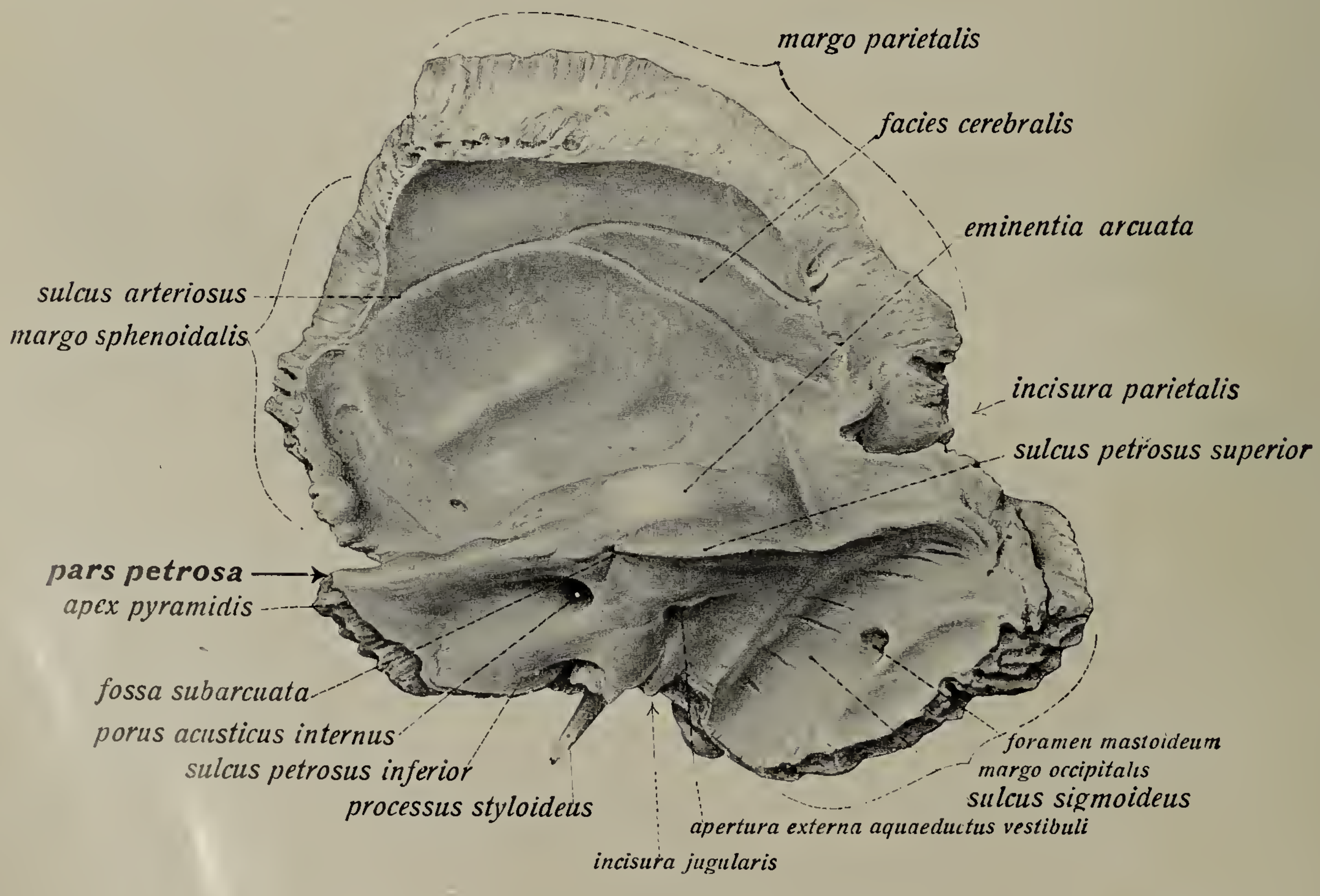
margo parietalis
facies cerebralis
eminentia arcuata
sulcus arteriosus
margo sphenoidalis
incisura parietalis
sulcus petrosus superior
pars petrosa
apex pyramidis
fossa subarcuata
porus acusticus internus
sulcus petrosus inferior
processus styloideus
foramen mastoideum
margo occipitalis
sulcus sigmoideus
apertura externa aquaeductus vestibuli
incisura jugularis

Fig. 58.

The Temporal Bone.

Fig. 57. The right temporal bone, lateral surface. ($^1/_1$)
Fig. 58. The right temporal bone, cerebral surface. ($^1/_1$)

The *temporal* bone has four parts: 1. the *squamous portion (squama temporalis)*, 2. the *mastoid portion*, 3. the *petrous portion* or *pyramid* and 4. the *tympanic portion*. These four parts group themselves around the external auditory opening, in such a way that the squamous part lies above it, the mastoid part behind, the tympanic part below and anterior, and the petrous part medial and anterior.

The **squamous portion** *(squama temporalis)* articulates by a strongly curved, irregular border with the great wing of the sphenoid *(margo sphenoidalis)* and with the parietal *(margo parietalis)*, the margins of the temporal bone overlapping those of the other bones in a squamous suture. Except for a small lower portion the squama is vertical in position and has an outer temporal and inner cerebral surface, the latter having ridges and depressions for the convolutions of the cerebral hemispheres and also grooves for the middle meningeal artery. It is more or less separated from the petrous portion by a *petro-squamosal fissure*, which tends to become obliterated in the adult. The temporal surface is smooth and presents a shallow groove for the middle temporal artery, beginning just above the external auditory opening. In addition there arises from the temporal surface the long *zygomatic process*, which articulates with the temporal process of the zygomatic bone. The process arises by a root from the vertical portion of the squama and by a second root from the small, lower, horizontal portion. Between the two roots lies the articular cavity for the head of the mandible *(fossa mandibularis)*, in front of which is an *articular tubercle*, also partly covered with cartilage. The zygomatic process is at first almost horizontal, but later twists so as to lie in the sagittal plane. From its posterior extremity the hinder part of the *temporal line* passes upwards and backwards to be continued upon the parietal bone. Above the external auditory opening there is usually a sharp projection, the *suprameatal spine*.

The **mastoid portion** has as its chief part the large *mastoid process*, which forms the whole outer surface of this portion of the bone; it articulates by the parietal notch with the mastoid angle of the parietal and by its occipital margin with the squamous portion of the occipital (occipito-mastoid suture). It possesses a concave inner (cerebral) surface and a strongly convex roughened outer surface. The latter forms the broad, conical mastoid process which contains cavities filled with air, the *mastoid cells*, which communicate with the tympanic cavity. It gives attachement to several muscles and towards its posterior border has a deep groove *(mastoid incisure)* for the digastric. Near the occipito-mastoid suture is a shallow groove for the occipital artery and the external opening of the *mastoid foramen*.

The principal part of the temporal bone, the **petrous portion** is also termed the **pyramid** and is a three-sided pyramidal structure lying almost horizontally. In the adult only its three surfaces can be seen, the base being almost covered by the tympanic portion of the bone; in the new-born child and even somewhat later it is visible on the outer surface of the bone (Fig. 61, 62). The schematic sections (Fig. 58a and b) show the arrangement of the four surfaces as well as the formation of the tympanic cavity and its continuation as the Eustachian tube (musculo-tubar canal) through the petrous and tympanic portions.

In the description that follows the parts of the bony labyrinth lying within the pyramid are not considered, nor is the tympanic cavity fully described. These parts will be described later (Vol. III).

Two surfaces of the petrous portion, the *anterior* and the *posterior*, look toward the skull cavity; the third, *inferior*, is at the base of the skull, while the *base* (not labelled) forms the medial wall of the tympanic cavity. The three surface are separated by angles; the *superior angle* separates the anterior and posterior surfaces, the *anterior* separates the anterior and inferior and the *posterior* the posterior and inferior surfaces. The axis of the pyramid is oblique to the long axis of the skull passing from behind and lateral, anteriorly and medially. The apex of the pyramid lies at the foramen lacerum.

The anterior surface forms a portion of the middle fossa of the skull. It is separated by the *petro-squamous fissure* from the squamous portion of the bone, and bears a slight elevation, the *arcuate eminence*, transverse to the axis, which is formed by the underlying semicircular canal.

The Temporal Bone. *(Cont.)*

Fig. 59. The right temporal bone seen from the cerebral surface and from the apex of the pyramid. ($^1/_1$)

Fig. 60. The right temporal bone from below. ($^1/_1$)

Fig. 61. The right temporal bone of a new born child (enlarged one half).

Fig. 62. The left temporal bone of a four year old child (enlarged one half).

In Fig. 61 and 62 the squamous portion is green, the petrous and mastoid portions yellow and the tympanic portion white.

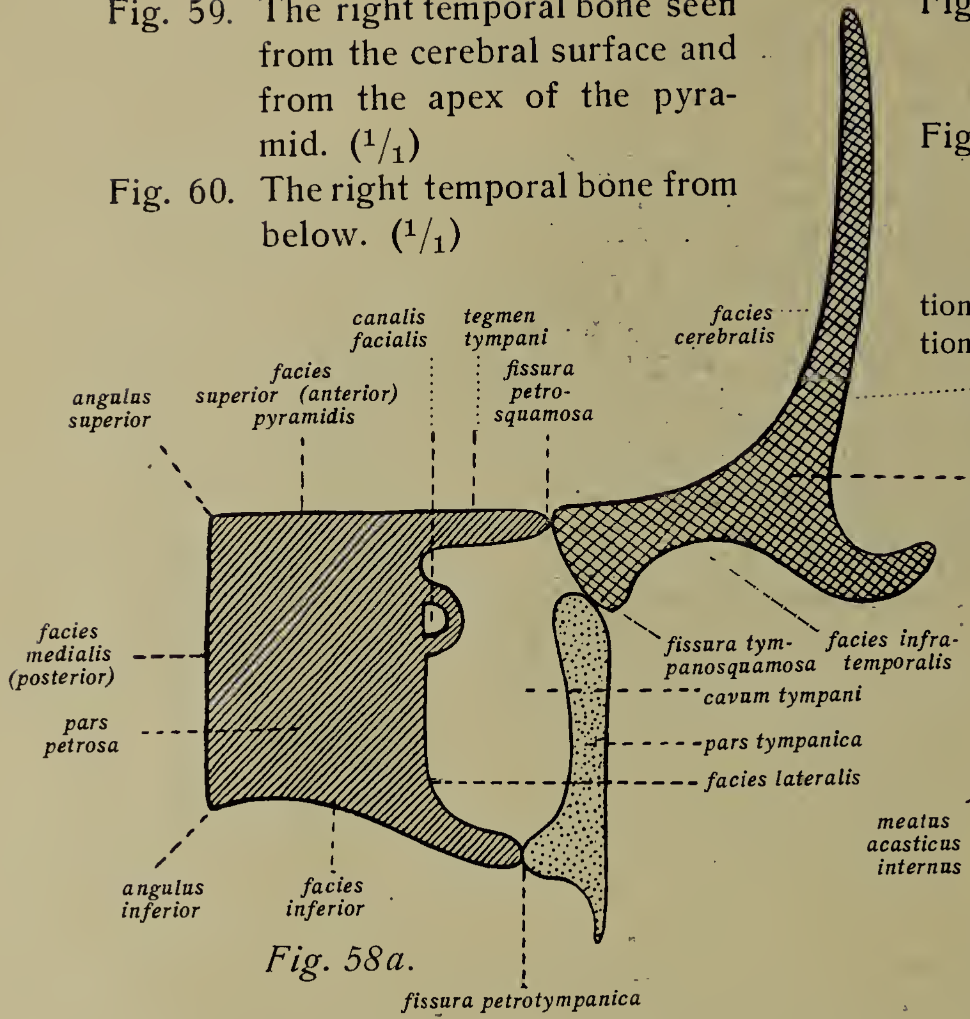

Fig. 58a.

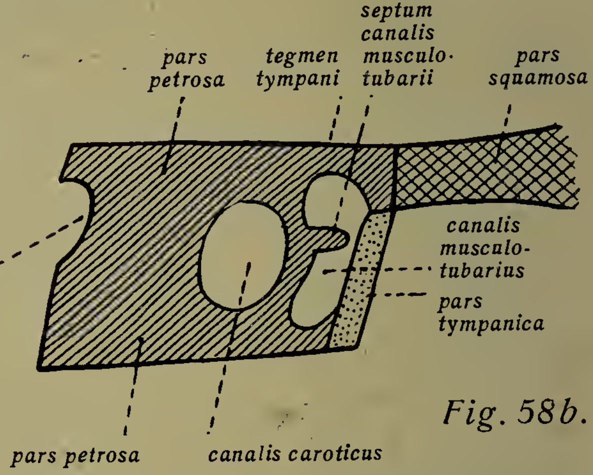

Fig. 58b.

Fig. 58a. Schematic transverse section of the temporal bone at the middle of its length (after Gaupp). Simply hatched = petrous portion; cross hatched = squamous portion; stippled = tympanic portion.

Fig. 58b. Schematic transverse section of the temporal bone near the apex of the pyramid. The shading as in Fig. 58a.

Further towards the median line is a slit-like opening the *hiatus of the facial canal,* with a groove for the great superficial petrosal nerve extending toward the foramen lacerum. Lateral and anterior to this is a second opening, the *aperture of the superior tympanic canaliculus,* with a similarly directed groove for the lesser superficial petrosal nerve. The part of the anterior surface of the pyramid that lies between the petro-squamous fissure and the arcuate eminence forms the roof of the tympanic cavity, the *tegmen tympani.* Near the apex of the pyramid is a very shallow *trigeminal impression* (See Fig. 46). The *superior angle* bears the *superior petrosal groove* and the *anterior angle* bounds the spheno-petrous fissure and the foramen lacerum.

The *posterior surface* of the pyramid forms a part of the posterior cranial fossa. It presents a roundish opening, the *internal auditory opening (porus acusticus internus),* which leads into a canal, the *meatus acusticus internus,* running obliquely into the bone. Above this opening, immediately below the superior angle, is small depression, the *subarcuate fossa,* and lateral to the auditory opening there is a fissure-like opening, the *external opening of the aquaeductus vestibuli,* which lodges a portion of the internal ear. A shallow groove, the *inferior petrosal sulcus,* runs parallel to the posterior angle, being a continuation of the similarly named groove on the occipital bone. The *apex* of the pyramid has an opening with an irregular boundary, the *internal carotid foramen* (see below). Beside it, near the anterior angle of the pyramid, is the opening of a large canal, the *Eustachian canal (canalis musculo-tubarius),* which leads into the tympanic cavity.

The *posterior angle* is separated from the occipital bone by the petro-occipital fissure and bears a shallow *jugular notch,* which, with the corresponding notch on the occipital forms the jugular foramen (see Fig. 46).

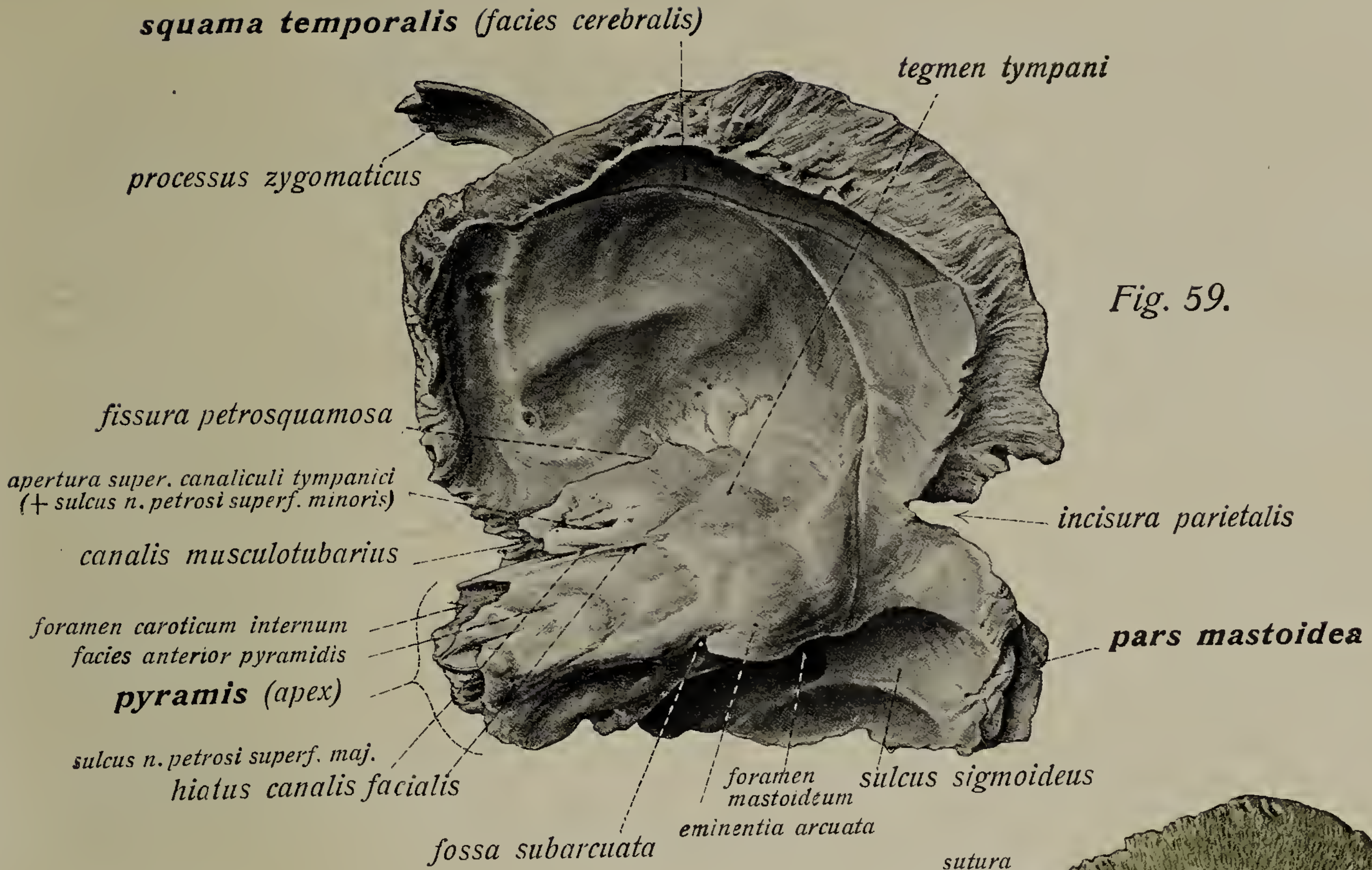

Fig. 59.

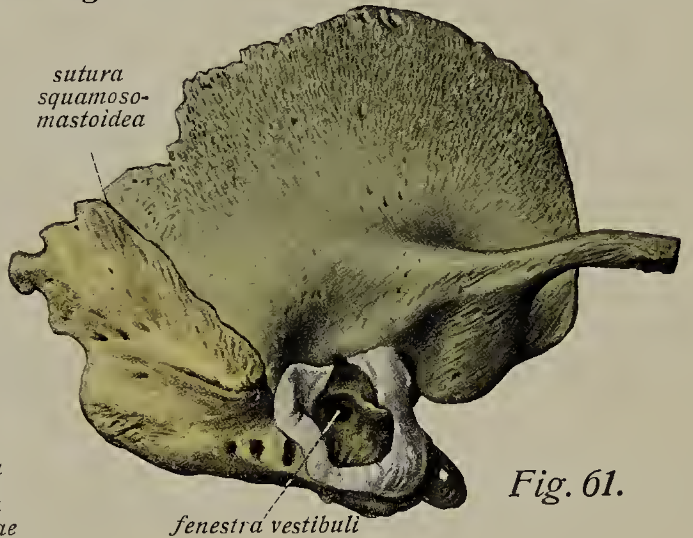

Fig. 61.

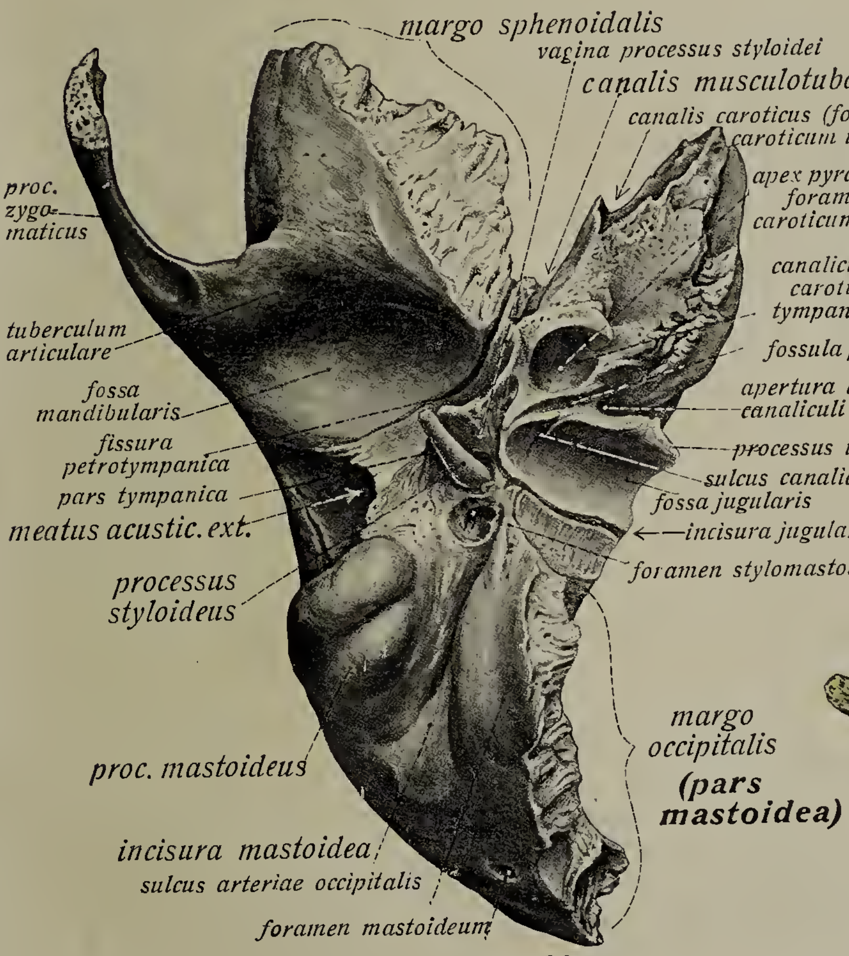

Fig. 60.

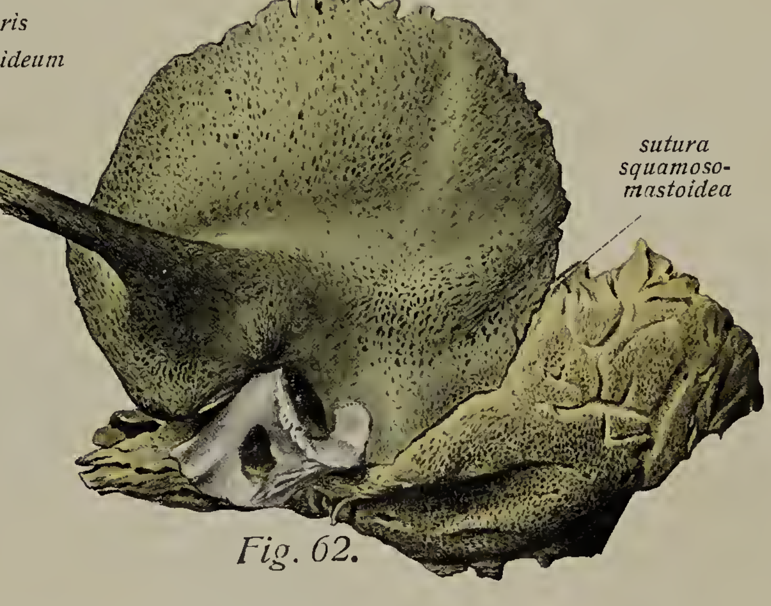

Fig. 62.

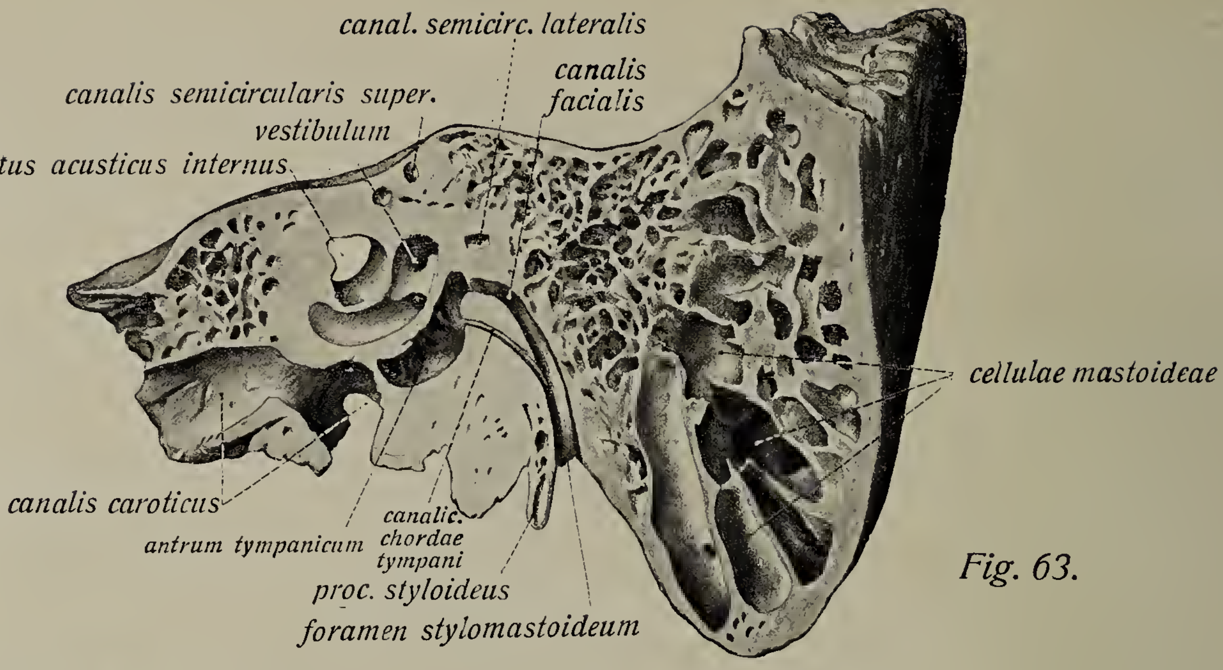

Fig. 63.

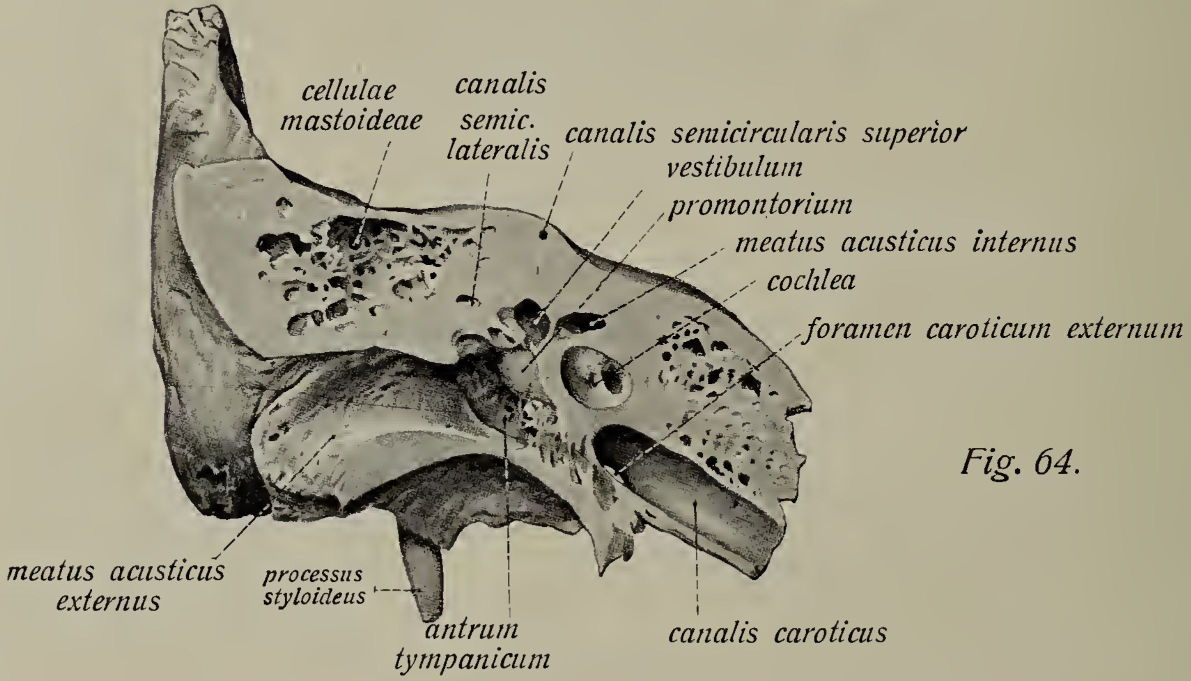

Fig. 64.

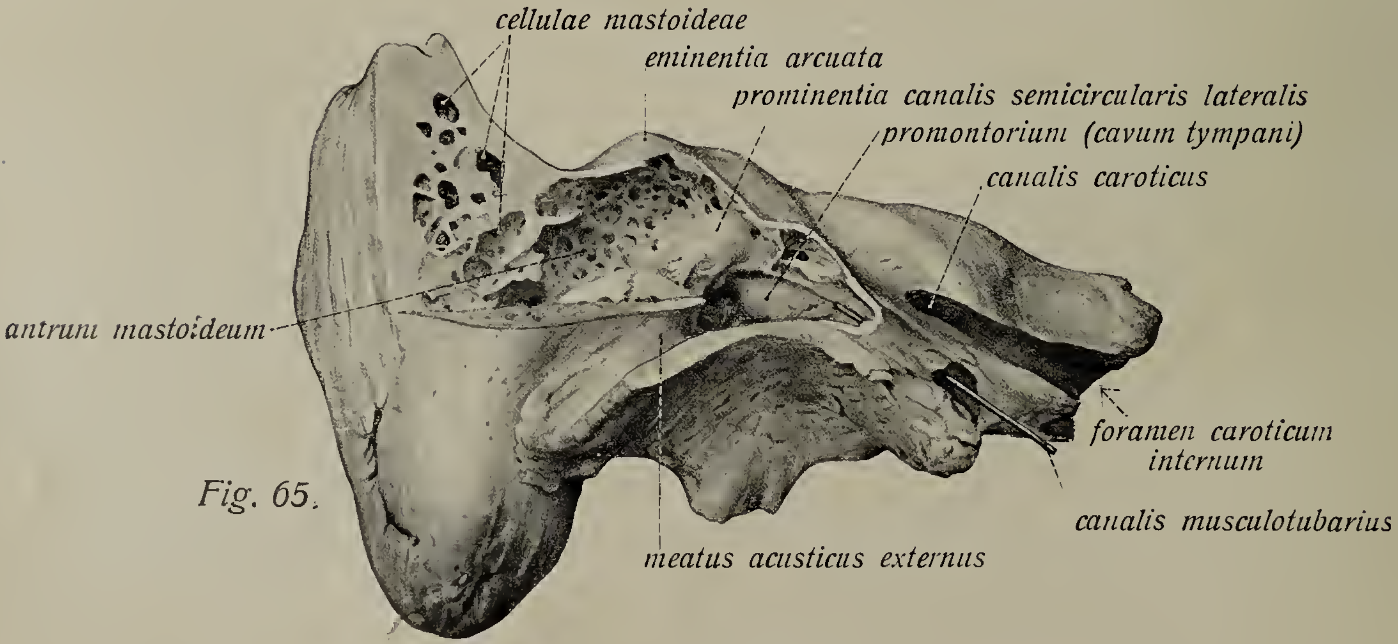
cellulae mastoideae
eminentia arcuata
prominentia canalis semicircularis lateralis
promontorium (cavum tympani)
canalis caroticus
antrum mastoideum
foramen caroticum internum
canalis musculotubarius
meatus acusticus externus

Fig. 65.

The Temporal Bone. *(Cont.)*

Fig. 63. The left temporal bone divided along the axis of the pyramid (enlarged about $^1/_4$).*)

Fig. 64. The right temporal bone divided in the direction of the external auditory meatus and almost parallel to the axis of the pyramid (enlarged about $^1/_4$).

Fig. 65. The right temporal bone divided so as to show the tympanic cavity; a sound is placed in the canal for the Eustachian tube *(canalis musculo-tubarius)* whose wall is partly chiselled away to show the septum (enlarged about $^1/_4$).

The *inferior surface* of the pyramid presents the *stylomastoid foramen* at the base of the mastoid process; it is the outer opening of the facial canal. In front of it lies the slender, often very long *styloid process,* whose base is partly ensheathed by a plate-like projection of the tympanic portion, the *vaginal process.* Close to the styloid process is a broad, elongated groove, the *jugular fossa,* which abuts medially upon the jugular notch and receives the bulb of the jugular vein. In the floor of the groove is the small *sulcus of the mastoid canaliculus.* On the posterior margin close to the jugular fossa is a small opening, the *external aperture of the cochlear canaliculus;* in front of this is the large round *external carotid foramen* and between this and the jugular fossa is a small depression, the *petrous fossula,* from which a small canal, the *tympanic canaliculus,* passes through the floor of the tympanic cavity.

The *base* of the petrous portion forms the medial wall of the tympanic cavity. In the adult it is covered in by the tympanic portion of the bone, so that only a small strip of it is visible at the surface along the petro-tympanic fissure.

The *tympanic cavity* is an air-containing cavity lying between the petrous and the tympanic portions. The external auditory meatus leads into it from without; its roof is formed by a thin part of the petrous portion, the *tegmen tympani,* while its floor is formed partly by the petrous and partly by the tympanic portion. Anteriorly and medially the cavity is continued into the canal for the Eustachian tube (canalis musculo-tubarius) and posteriorly and laterally it has opening into it the antrum and the mastoid cells. It contains the three small auditory ossicles, which together with the walls of the cavity will be described in connection with the auditory organ (Volume III).

The **tympanic portion** of the temporal bone is a small trough-shaped plate of bone which forms the sides and floor of the external auditory meatus and the lateral wall of the tympanic cavity. It is separated from the petrous and squamous portions by the *petro-tympanic fissure* (fissure of Glaser), from the mastoid portion by the *tympano-mastoid fissure* and it forms the vagina of the styloid process.

The temporal bone of the new-born child differs markedly from that of the adult in that the tympanic portion has the form of a ring that is open above, and there is practically no mastoid process. The squamoso-mastoid suture is still quite distinct, separating the squamous portion from the mastoid and petrous portions, which form a single mass. In the course of the first year the tympanic ring becomes the trough-like structure, which at first has in its floor a constant foramen.

Canals in the temporal bone. The *facial* canal, mainly for the facial nerve, begins at the bottom of the internal auditory meatus and runs at first horizontally and almost transversely to the axis of the petrous portion to the *hiatus of the facial canal.* There it bends at a right angle and runs in the medial wall of the tympanic cavity, again almost horizontally, but in the line of the axis of the pyramid, until it reaches the pyramidal eminence of the *tympanic antrum* (see Vol. III). Here it bends to assume a vertical direction and opens by the stylomastoid foramen. From the lower portion of the canal the *canaliculus for the chorda tympani* leads to the tympanic cavity.

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*) The designations partly refer to the chapters on the ear (see Vol. III).

The *carotid canal* is a short, but wide canal, situated near the apex of the pyramid. It begins at the external carotid foramen and runs at first vertically, but later bends almost at a right angle so as to run horizontally, and ends at the internal carotid foramen. Small canals, the *carotico-tympanic canaliculi,* lead from it into the tympanic cavity.

The canal for the *Eustachian tube (canalis musculo-tubarius)* runs parallel with and immediately adjacent to the horizontal portion of the carotid canal, almost in the axis of the pyramid. It begins as a notch on the anterior angle of the pyramid, between that part of the bone and the squamous portion, and ends on the anterior wall of the tympanic cavity of which it seems to be a direct prolongation. An incomplete horizontal septum divides it into an upper canal for the Tensor tympani and a lower one for the Eustachian tube (tuba auditiva).

The *tympanic canaliculus* leads from the petrous fossula into the tympanic cavity, where it becomes the sulcus promontorii, and then leaves the cavity by its upper wall to open by the superior aperture of the tympanic canaliculus on the anterior surface of the pyramid.

The *mastoid canaliculus* begins as a groove in the jugular fossa, passes through the lower portion of the facial canal and opens in the tympano-mastoid fissure.

The Parietal Bone.

Fig. 66. The outer surface of the right parietal bone. ($^4/_5$)

The parietal protuberance is not well defined.

Fig. 67. The inner surface of the right parietal bone. ($^4/_5$)

The arterial sulcus is converted into a canal for a short distance at its commencement; the bone being from a young individual shows no granular foveolae.

The *parietal bone* is a large quadrangular flat bone, convex on its outer surface and concave on its inner. The four borders are 1. the *frontal,* which articulates with the frontal bone in the coronal suture; 2. the *sagittal,* which articulates with the other parietal in the sagittal suture; 3. the *occipital,* which articulates with the occipital bone in the lambdoid suture and 4. the *squamosal,* which articulates with the temporal bone in the squamous suture. The four angles of the bone are the *frontal* situated at the junction of the sagittal and coronal sutures, the *occipital* at the junction of the sagittal and lambdoid sutures, the *mastoid* at the parieto-mastoid suture, where it occupies the parietal notch of the temporal bone, and the *sphenoidal* which articulates in the spheno-parietal suture with the great wing of the sphenoid. This last angle is the sharpest.

The outer convex surface presents at the region of greatest curvature the *tuberosity* and also stronger *superior* and weaker *inferior temporal lines*, both of which have and arched course. Below the latter the parietal forms a part of the temporal surface (see Fig. 41, 42). In this region the squamosal border is rough, being overlapped by the squamous portion of the temporal bone. Near the posterior end of the sagittal border and close to the sagittal suture is the *parietal foramen.*

The *inner (cerebral) surface* shows well marked arterial grooves, especially on the anterior part of the bone, produced by the branches of the middle meningeal artery. At the sagittal border there is the one half of the *sagittal sulcus* and at the mastoid angle one sees a short portion of the *sigmoid sulcus.* Not infrequently the cerebral surface presents *digitate impressions* and *juga cerebralia* and frequently also *Pacchionian depressions (foveolae granulares)* which may be of considerable depth, especially in middle and old age.

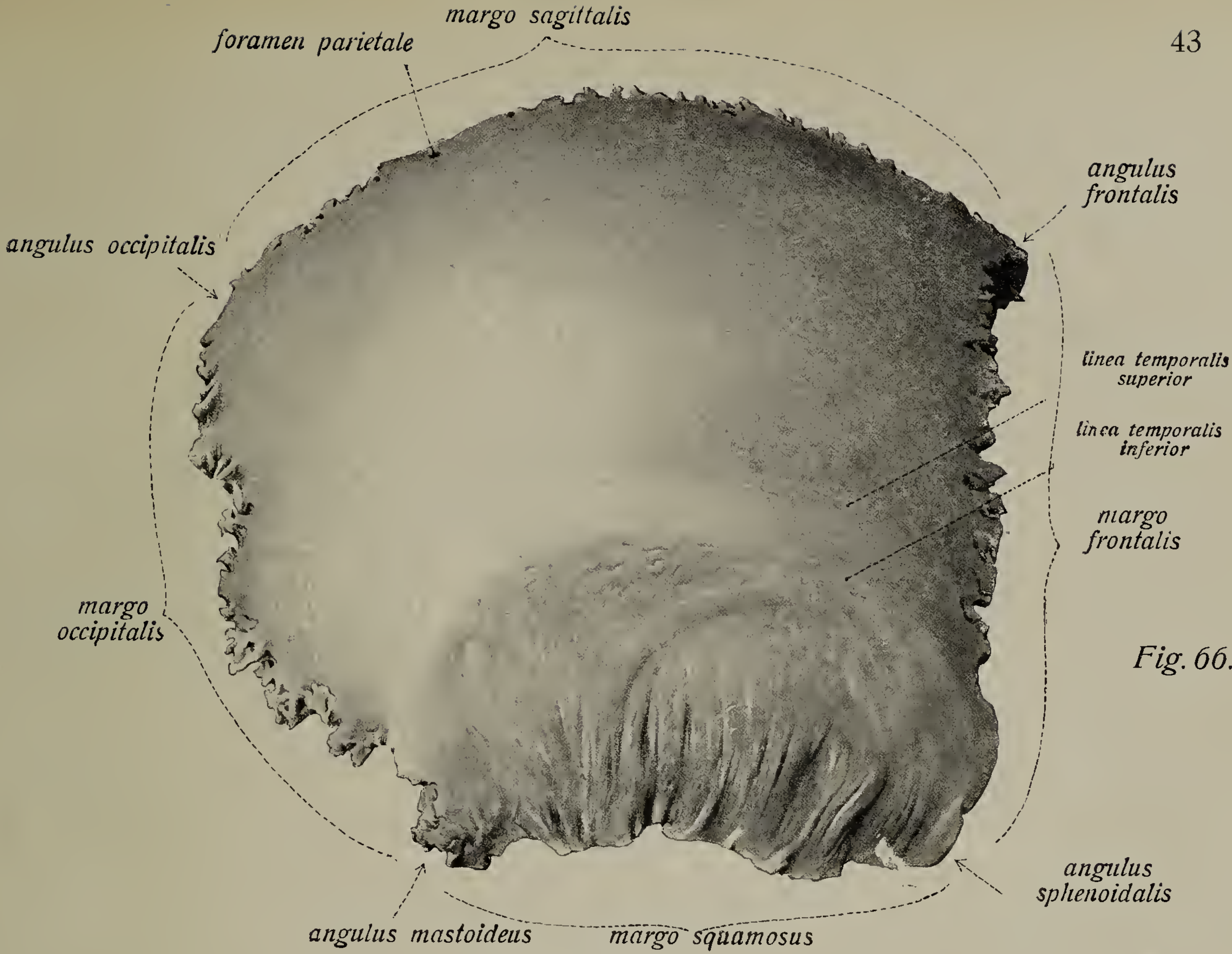
margo sagittalis
foramen parietale
angulus frontalis
angulus occipitalis
linea temporalis superior
linea temporalis inferior
margo frontalis
margo occipitalis
angulus sphenoidalis
angulus mastoideus
margo squamosus

Fig. 66.

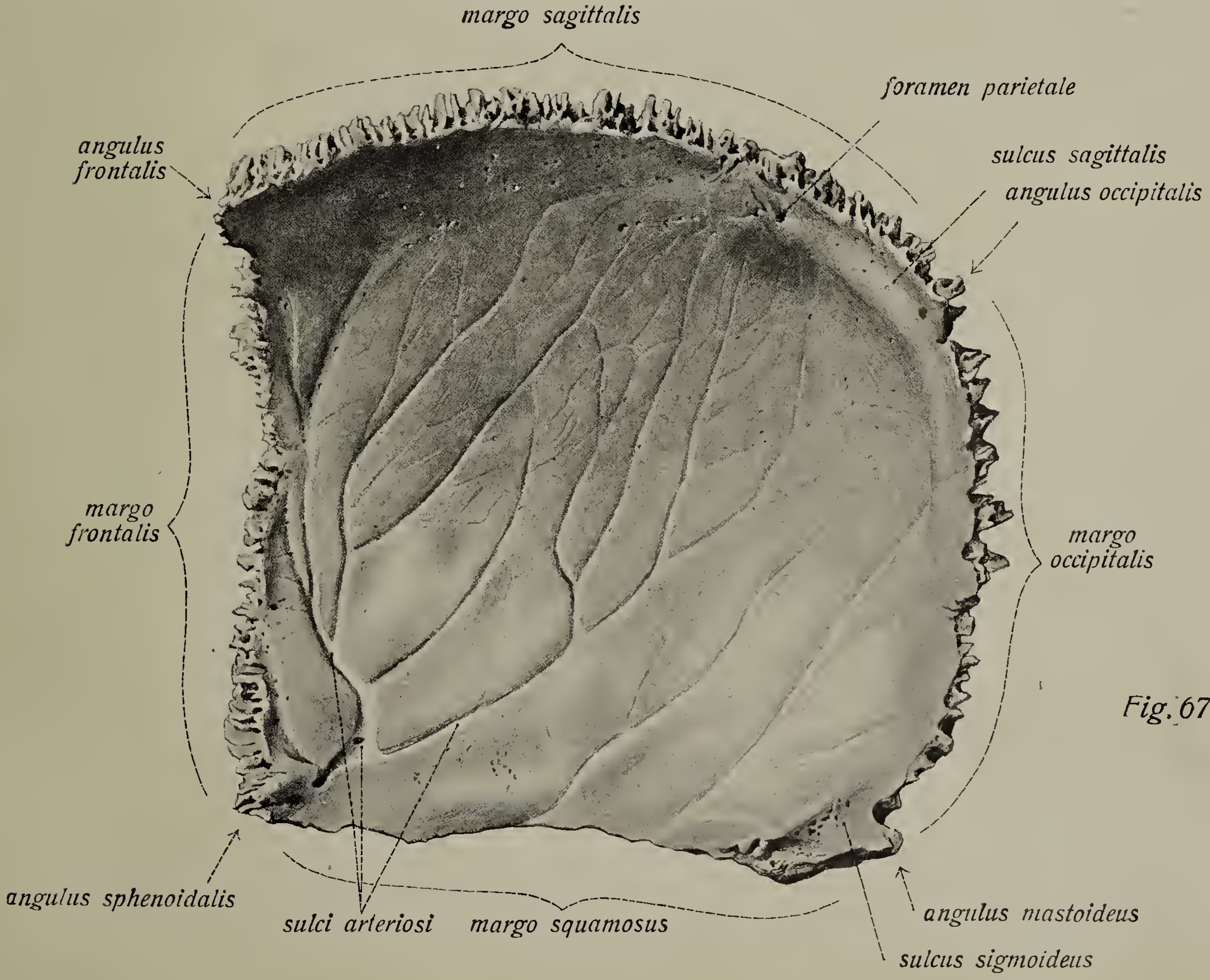
margo sagittalis
foramen parietale
sulcus sagittalis
angulus frontalis
angulus occipitalis
margo frontalis
margo occipitalis
angulus sphenoidalis
sulci arteriosi
margo squamosus
angulus mastoideus
sulcus sigmoideus

Fig. 67.

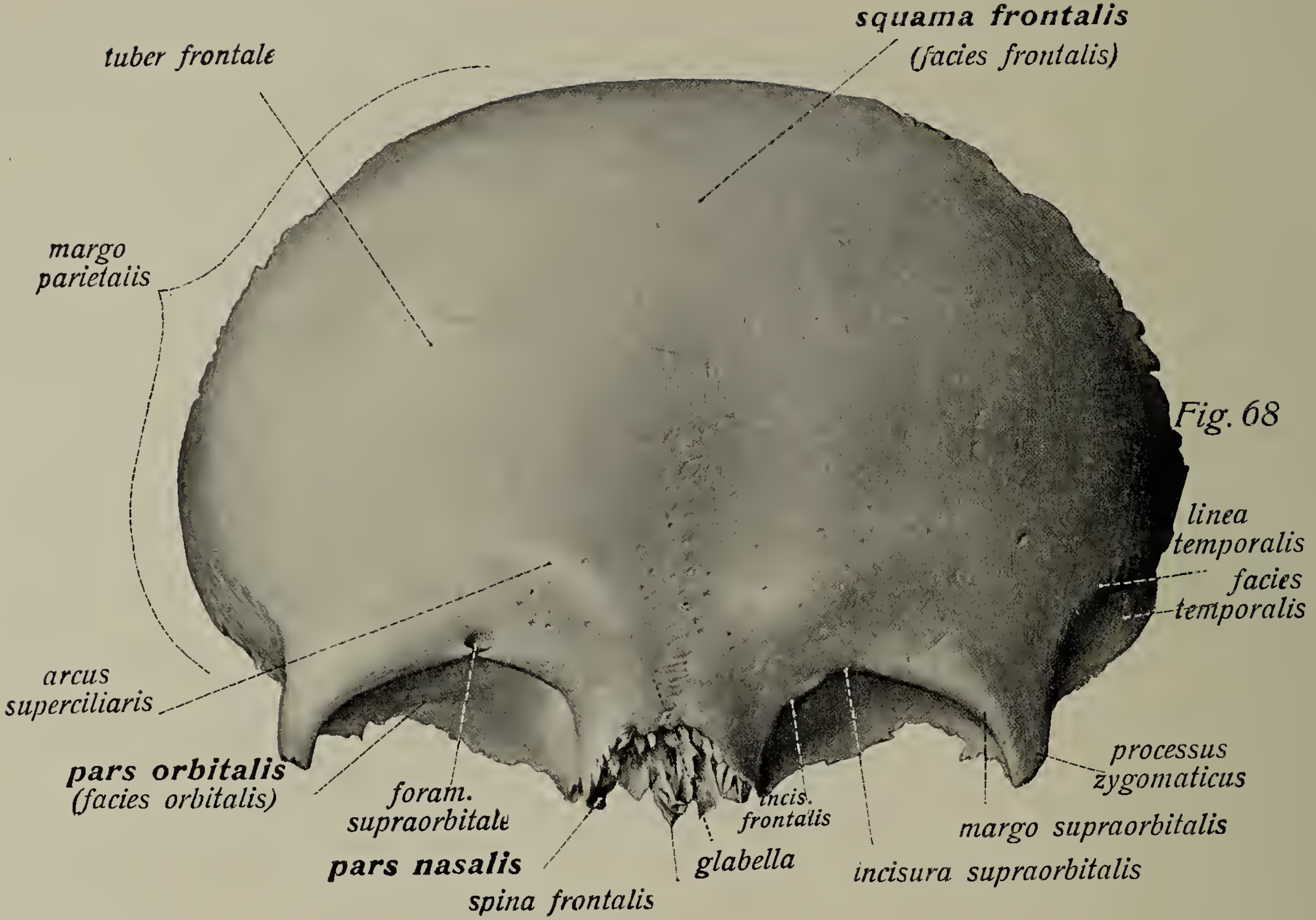
squama frontalis
(facies frontalis)
tuber frontale
margo parietalis
linea temporalis
facies temporalis
arcus superciliaris
pars orbitalis
(facies orbitalis)
foram. supraorbitale
incis. frontalis
processus zygomaticus
margo supraorbitalis
pars nasalis
glabella
incisura supraorbitalis
spina frontalis

Fig. 68

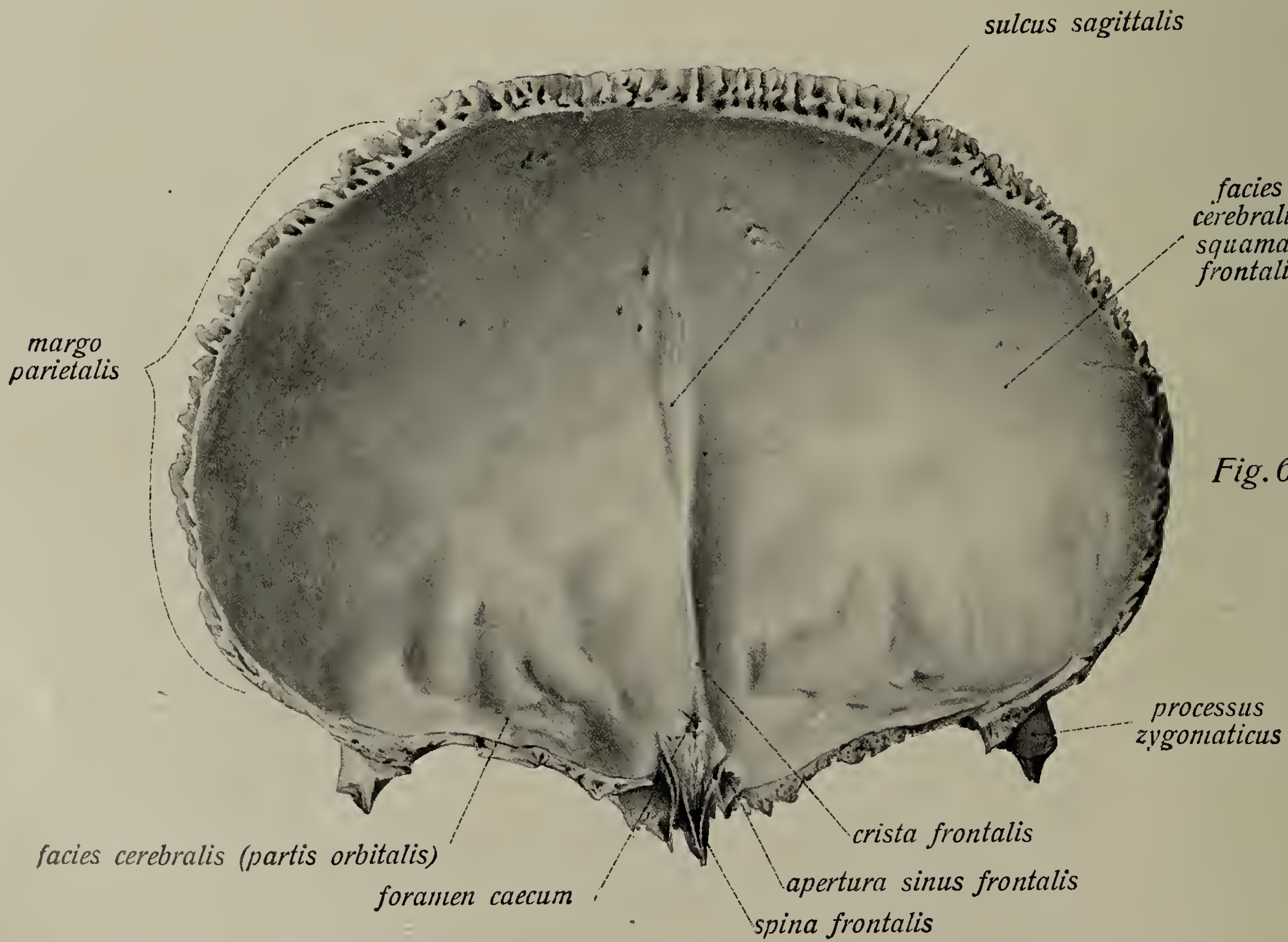
sulcus sagittalis
facies cerebralis squamae frontalis
margo parietalis
processus zygomaticus
facies cerebralis (partis orbitalis)
crista frontalis
apertura sinus frontalis
foramen caecum
spina frontalis

Fig. 69.

The Frontal Bone.

Fig. 68. The frontal bone from in front. ($^4/_5$)

Fig. 69. The frontal bone from behind ($^4/_5$)
Some small foveolae granulares are unlabelled.

The *frontal* bone consists of two unpaired portions, the *frontal plate* and the *nasal portion,* while the *orbital portions* are paired.

The *frontal plate* forms the principal part of the bone. It *articulates* by its parietal border with both parietals in the coronal suture and by its sphenoid border with the great wing of the sphenoid in the spheno-frontal suture. The outer surface is strongly convex and presents at the middle of each half the *tuber frontale.* Above the margins of the orbits are two arched projections, the *supraciliary arches,* and between these the somewhat depressed *glabella.* The upper border of the orbit separates the frontal plate from the orbital portion. Its lateral part is formed by the *zygomatic process* which unites with the fronto-sphenoidal process of the zygomatic bone in the zygomatico-frontal suture. From the zygomatic process the *temporal line* takes origin and separates from the frontal surface a small almost vertical portion, the *temporal surface.* In the inner half of the supraorbital border are two notches, the medial *frontal notch* and the lateral *supraorbital notch,* this latter being frequently converted into a foramen, the *supraorbital foramen.*

The cerebral surface of the frontal plate possesses in its lower portion a median ridge: the *frontal crest.* This begins below at a foramen, the *foramen caecum,* bounded by the frontal and ethmoid bones in common, and running upwards into the *sagittal sulcus.* The surface is smooth, except for some *digitate impressions* and *juga cerebralia,* as well as *Pacchionian depressions (foveolae granulares).* It passes over without sharp demarcation into the cerebral surface of the orbital portion.

The *orbital portions* are separated from one another by a deep *ethmoidal notch* which receives the lamina cribrosa of the ethmoid. Each possesses an upper cerebral and a lower orbital surface. The former shows very abundant *digitate impressions*; the latter is concave and forms the roof of the orbital cavity. It presents on its medial portion a small depression, the *fovea trochlearis,* (occasionally also a *trochlear spine)* and on its lateral part a shallow depression, the *lacrimal fossa,* for the lacrimal gland. The borders of the ethmoidal notch are broad and rough since they bear the *ethmoidal foveolae,* which complete the ethmoidal cells. Furthermore they bear an anterior and posterior groove (or short canal), which serve to form the *anterior* and *posterior ethmoidal foramina.*

The Frontal and Ethmoid Bones.

Fig. 70. The frontal bone from below ($^4/_5$)

Fig. 71. The frontal bone with the greater part of the ethmoid and nasal bones, from below. The frontal is white, the ethmoid orange and the nasals red. ($^4/_5$)

Fig. 72. The ethmoid bone from above ($^1/_1$)

Fig. 73. The ethmoid bone from the side. ($^1/_1$)

Fig. 74. The ethmoid bone with attached sphenoidal conchae from above and somewhat from behind. ($^1/_1$)

The *nasal portion* of the frontal is the small, median part that unites the two supraorbital margins. It has an irregular, rough surface, for articulation with the nasal bones and the frontal processes of the maxilla and, in addition, the *frontal* spine, directed, downwards and serving for the fixation of the bones that form the skeleton of the nose. Near the spine lie the openings of the *frontal sinus,* which is divided into two parts by a septum.

The *ethmoid* is an irregular, cubical bone in which a middle unpaired and two lateral paired portions may be distinguished. The middle portion consists of a horizontal plate, the *lamina cribrosa,* and a vertical plate, the *lamina perpendicularis.* The paired lateral portions are attached to the lateral edges of the lamina cribrosa and are known as the ethmoidal labyrinths.

The *lamina cribrosa* occupies the ethmoidal notch of the frontal bone and is a rectangular plate situated between the nasal and cranial cavities. It is perforated by a number of roundish foramina, through which the branches of the olfactory nerve pass to the nasal cavity. At its middle it bears a thick ridge, high in front and diminishing posteriorly, the *crista galli.* In front of this are two small processes of the lamina cribrosa, the *alar processes*, which usually assist in the boundary of the foramen caecum.

The *lamina perpendicularis* is a thin pentagonal plate which forms the upper anterior part of the nasal septum. It is attached by its anterior, upper border to the frontal spine of the frontal, by its upper border it is fused with the lamina cribrosa, by its posterior border it articulates with the sphenoidal crest, by its lower border with the upper border of the vomer and by its anterior lower border with the cartilaginous nasal septum. (see also Fig. 75.)

The ethmoidal labyrinth hangs almost vertically downwards from the lateral border of the lamina cribrosa. It contains numerous, air-containing, imperfectly separated spaces, the *ethmoidal cells,* which in part are completely in the ethmoid itself, but for the most part are partly bounded by other bones, the maxilla, lacrimal, frontal, sphenoid and palatine. The lateral wall of the labyrinth, by its thin *lamina papyracea,* forms a part of the medial orbital wall. Upon it or in the suture between it and the orbital portion of the frontal lie the *anterior* and *posterior ethmoidal foramina.*

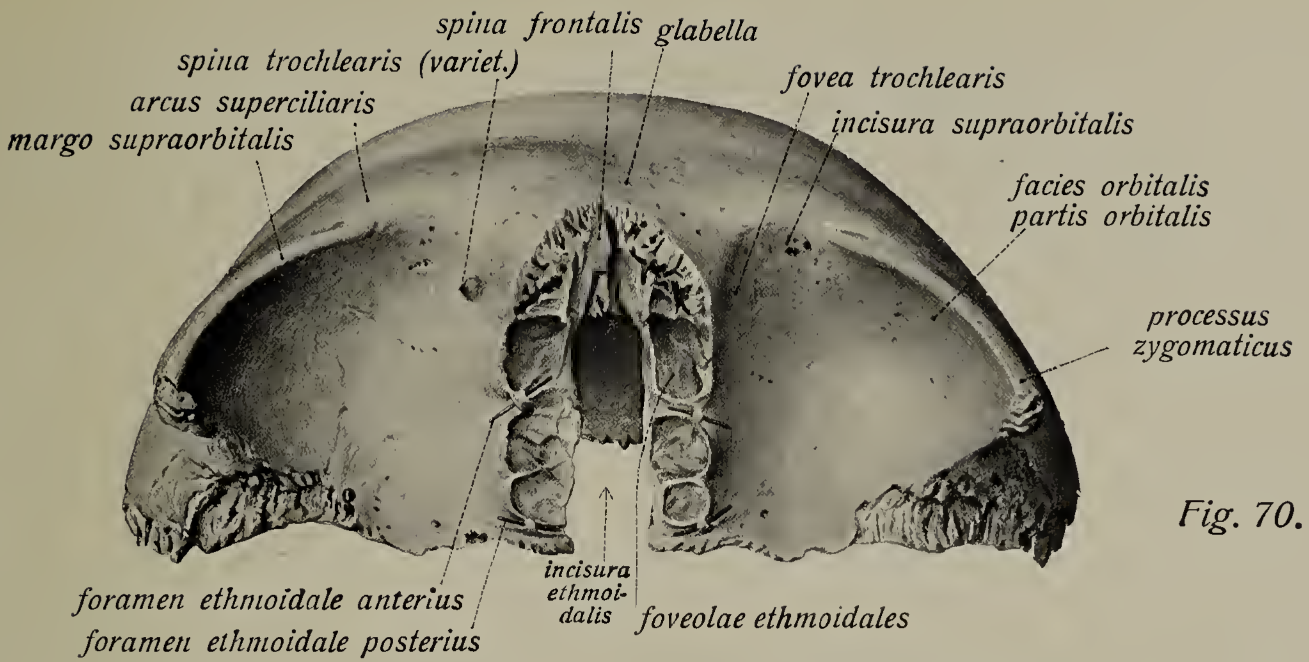

Fig. 70.

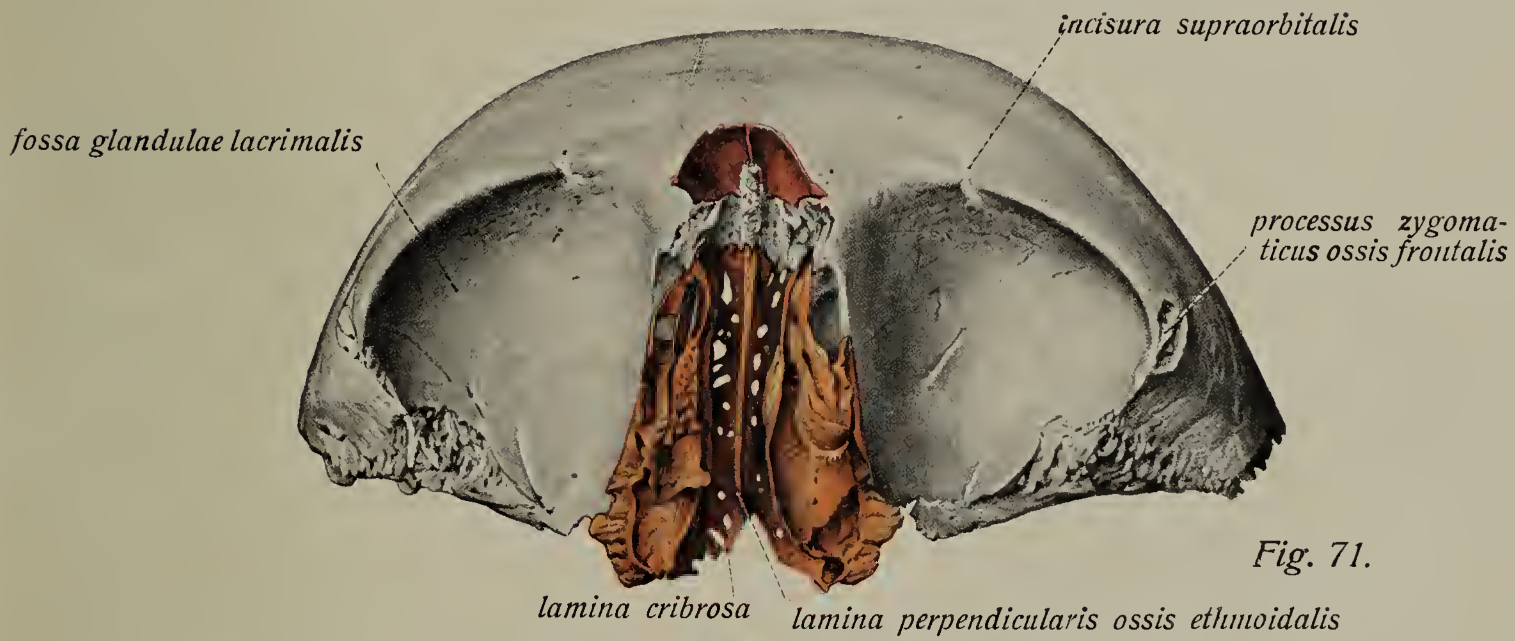
incisura supraorbitalis
fossa glandulae lacrimalis
processus zygomaticus ossis frontalis
lamina cribrosa
lamina perpendicularis ossis ethmoidalis

Fig. 71.

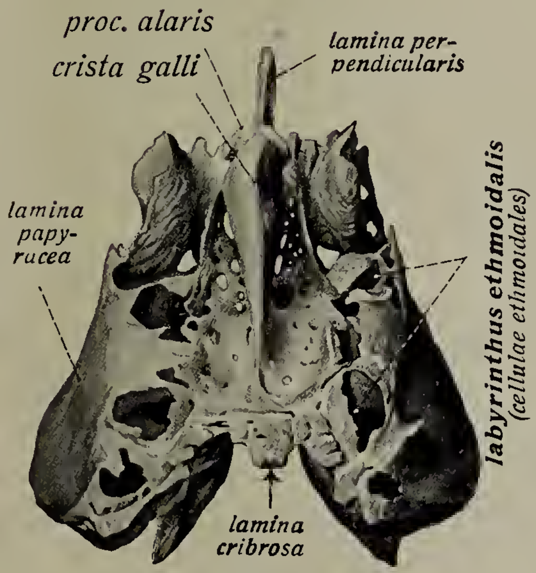

Fig. 72.

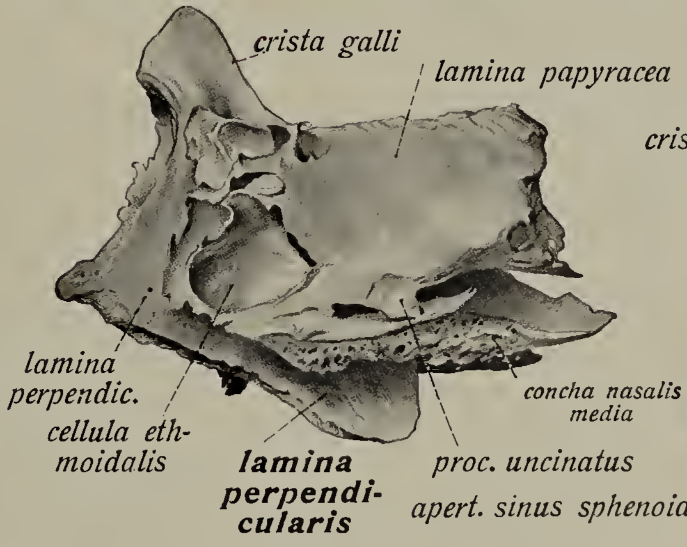

Fig. 73.

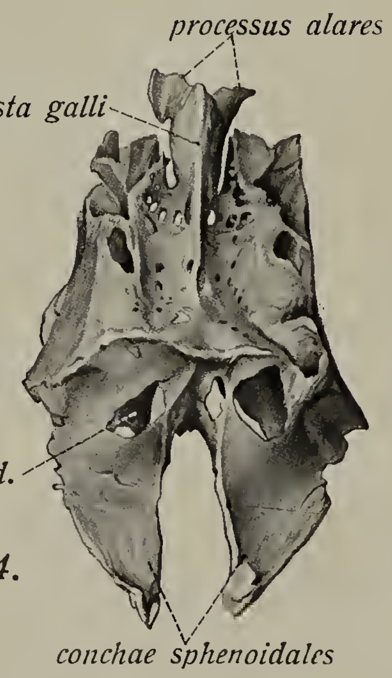

Fig. 74.

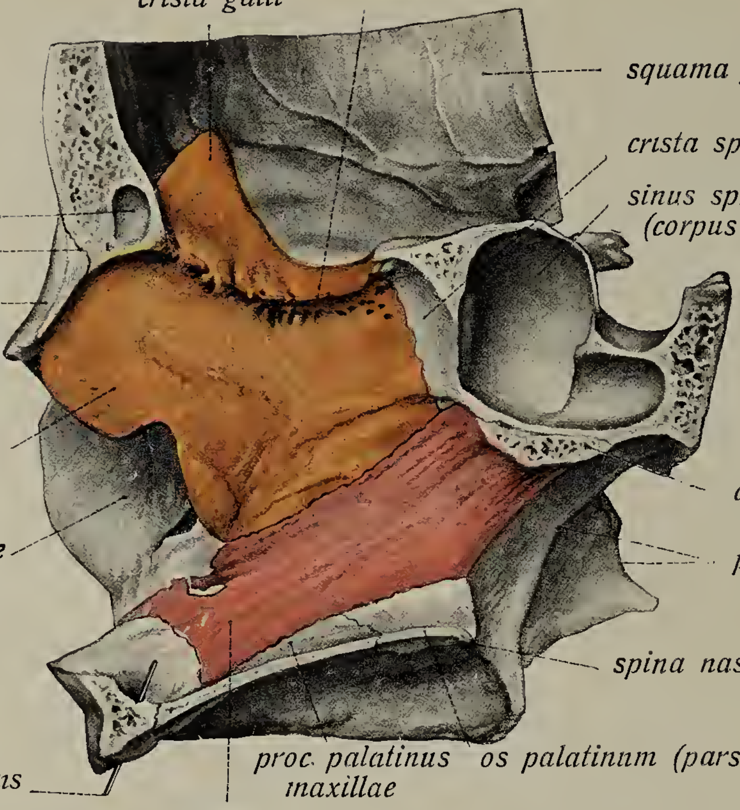

Fig. 75.

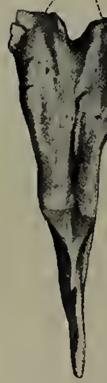

Fig. 76.

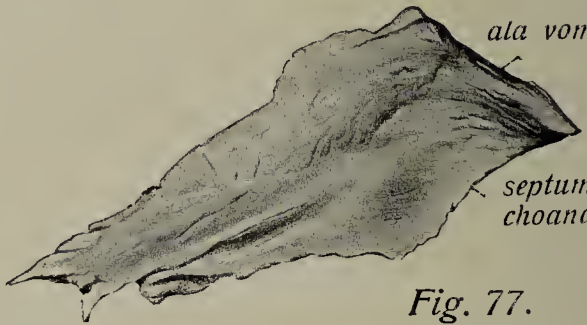

Fig. 77.

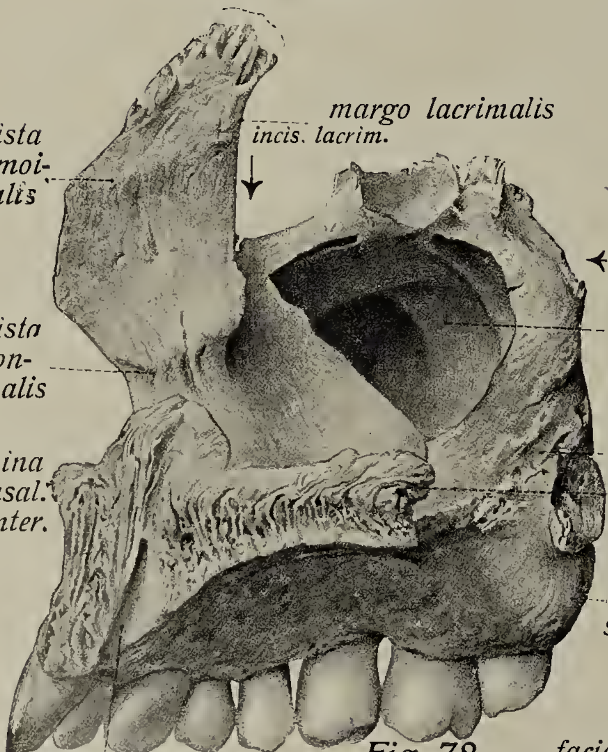

Fig. 78.

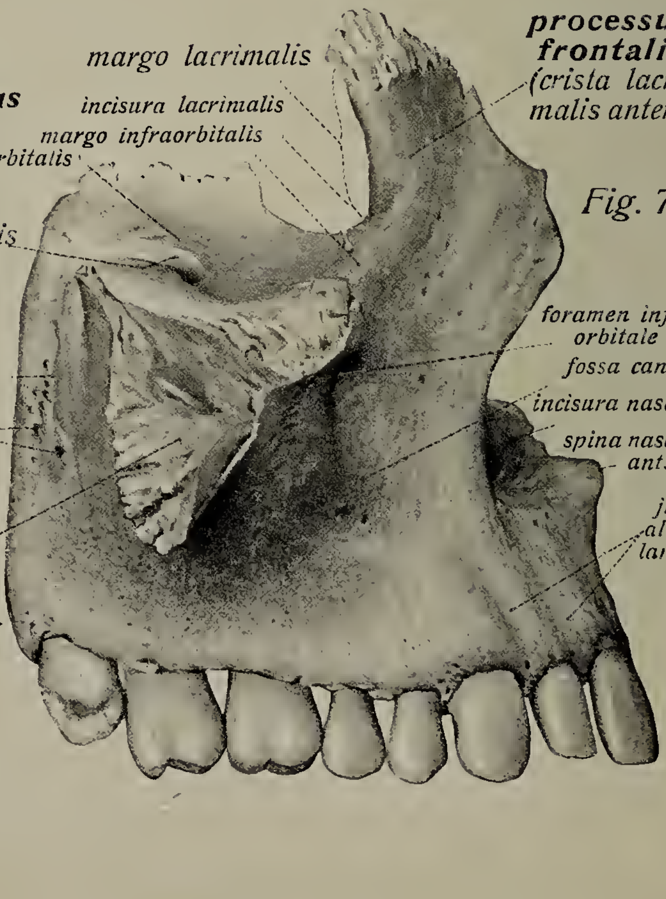

Fig. 79.

The Ethmoid Bone, the Vomer and the Maxilla.

Fig. 75. The bony nasal septum from the left side.
The frontal, sphenoid, maxilla and palatine bones have been cut away near the median line; the left ala of the vomer has also been removed. The ethmoid is orange, the vomer is red. ($^4/_5$)

Fig. 76. The vomer from behind. ($^1/_1$)

Fig. 77. The vomer from the side. ($^1/_1$)

Fig. 78. The right maxilla from its medial surface. ($^1/_1$)

Fig. 79. The right maxilla from its lateral surface. ($^1/_1$)

The medial wall of the ethmoidal labyrinth forms the greater part of the lateral wall of the nasal cavity. It possesses two parallel projections, having the form of thin plates, curved upon themselves at their lower border, the *nasal conchae*. The *superior concha* is markedly smaller and shorter than the *middle* (see p. 62). The latter projects beyond the labyrinth both anteriorly and posteriorly and is attached by its ends to the ethmoidal crests of the maxilla and palatine bones. It sends downwards a hook shaped *processus uncinatus,* which partly covers the opening of the maxillary sinus (see p. 50 and Fig. 83).

The **vomer** is a flat, quadrangular bone which forms the lower and posterior portion of the nasal septum. Its upper end is thickened and cleft into two *alae,* which enclose the rostrum of the sphenoid. The small anterior border articulates with the cartilaginous part of the nasal septum, the upper border with the lower border of the lamina perpendicularis of the ethmoid, the lower border with the nasal crest of the maxilla and palatine and the posterior border forms the septum of the choanae.

The **maxilla** is a paired bone which takes part in the boundaries of the orbital, nasal and oral cavities. In it may be distinguished the body *(corpus)* and four processes. The body is irregularly cubical and encloses a large air-containing cavity, the *maxillary antrum* or *sinus,* which communicates by a wide opening with the nasal cavity. The body has four surfaces. The *anterior* is the facial surface and is convex; its upper *infraorbital border* forms part of the lower border of the orbit, below which is the *infraorbital foramen,* the opening of the infraorbital canal, and below this a shallow depression, the *canine fossa.* The *orbital surface* is triangular and forms the greater part of the floor of the orbit, bounding the inferior orbital fissure medially. It possesses a groove, the *infraorbital groove,* which gradually becomes converted into a canal. The *lacrimal notch* near the root of the frontal process, receives the hamulus of the lacrimal bone. The *infratemporal surface* is the posterior surface and forms the boundaries of the infratemporal and pterygopalatine fossae. The swollen end of this portion of the bone is termed the *tuberosity;* it presents several small *alveolar foramina* and also a *pterygo-palatine groove,* which completes the canal of the same name (see p. 34).

The *nasal surface* forms the lower part of the lateral wall of the nasal cavity, but in its posterior portion it is covered in by the posterior part of the perpendicular portion of the palatine bone. It presents the wide irregular opening of the *maxillary sinus,* in front of which is a broad groove, the *lacrimal groove* (see below), and at the junction of the nasal surface with the frontal process the *conchal crest* (see below).

The *frontal process* of the maxilla is directed upwards and articulates by its upper border with the nasal portion of the frontal bone in the fronto-maxillary suture, by its *lacrimal border* with the lacrimal bone and by its medial border with the nasal bone.

The Maxilla, Lacrimal Bone, Inferior Concha and Palatine Bone.

Fig. 80. The lacrimal bone, outer surface. ($^1/_1$)
Fig. 81. The lower portion of the facial skeleton from above. ($^1/_1$)
Fig. 82. The right maxilla and palatine bone from within. ($^1/_1$)
Fig. 83. The right maxilla, palatine bone and inferior concha, with a portion of the ethmoid seen from within. ($^1/_1$)
Fig. 84. The inferior concha, lateral surface. ($^1/_1$)

In Fig. 81 and 83 the maxilla is yellow, the palatine blue, the sphenoid green and the ethmoid orange; in Fig. 82 the palatine is blue and the maxilla white.

It presents an outer and inner surface; the latter forms part of the lateral wall of the nasal cavity and bears an *ethmoidal crest* for articulation with the anterior part of the middle concha and below this a *conchal crest* for the inferior concha. Behind the process is the broad *lacrimal groove,* which, with a similar groove on the lacrimal bone forms the *fossa for the lacrimal sac.* The anterior wall of the groove is termed the *anterior lacrimal crest.* The *zygomatic process* is a broad, short, triangular process, projecting laterally to articulate with the zygomatic bone in the *zygomatico-maxillary suture.* The *alveolar process* is convex externally and concave on its inner surface, passing without distinct demarcation into the body on the one side and the palatine process on the other. The processes of the two maxillae meet in the *intermaxillary suture,* which ends anteriorly in the *anterior nasal spine.* The alveolar process forms the lateral and lower boundary of the *piriform aperture.* Its lower border is the alveolar border *(limbus alveolaris)* and bears the sockets for eight teeth, separated by *interalveolar septa.* The anterior surface of the process usually shows *juga alveolaria,* corresponding to the roots of the anterior teeth. The *palatine process* forms the greater portion of the hard palate and projects medially from the inner surface of the body. It is rough and uneven on its oral surface, smooth and concave on its nasal surface. The two processes unite by thickened borders to form the anterior part of the *median palatine suture,* which, on the nasal surface, forms the *nasal crest.* Anteriorly in the line of the suture is the *incisive canal,* which begins in an *incisive notch* on each maxilla and terminates on the nasal surface in two *incisive foramina* one on either side of the nasal crest.

The **lacrimal bone** is a very thin, flat, quadrangular bone that lies in the medial wall of the orbit between the frontal process of the maxilla and the lamina papyracea of the ethmoid. It presents *orbital* and *ethmoidal surfaces.* The latter closes certain of the ethmoidal cells and articulates on the lateral wall of the nasal cavity with the lacrimal process of the inferior concha. The former presents anteriorly the *lacrimal groove,* which is bounded posteriorly by the *posterior lacrimal crest.* This ridge runs downwards and terminates in a hook-like process, the *hamulus,* which fits into the lacrimal notch of the maxilla. Behind the ridge the orbital surface of the lacrimal forms a part of the medial wall of the orbit.

The **inferior concha** is a small, thin, porous bone whose free medial border is curled on itself, while the lateral border is attached to the conchal crests of the maxilla and palatine bone. It has three processes; the *maxillary process* extends downwards and laterally to the maxilla and closes a considerable portion of the opening of the maxillary sinus; the *lacrimal process* ascends to the lacrimal bone and forms a part of the posterior wall of the nasolacrimal canal; the *ethmoidal process* articulates with the uncinate process of the ethmoid, anterior to the opening of the maxillary sinus.

The **palatine bone** is a flat bone formed of two plates arranged at right angles to one another; one is the *horizontal portion* and the other the *perpendicular portion.* The horizontal portions of the two bones form the posterior part of the hard palate and resemble in every par-

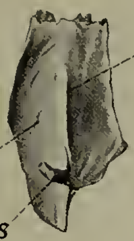

Fig. 80.

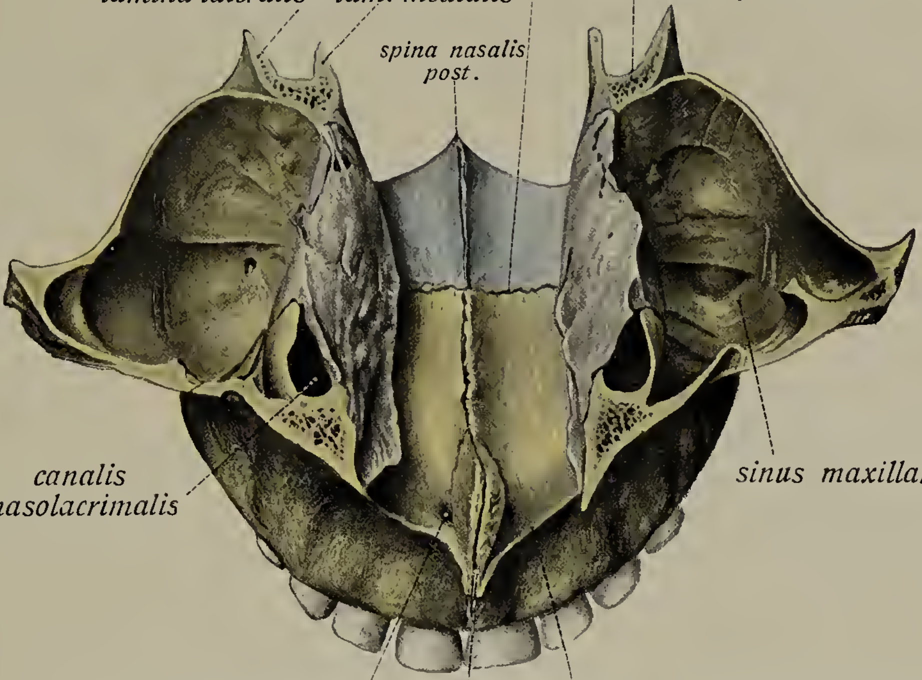

Fig. 81.

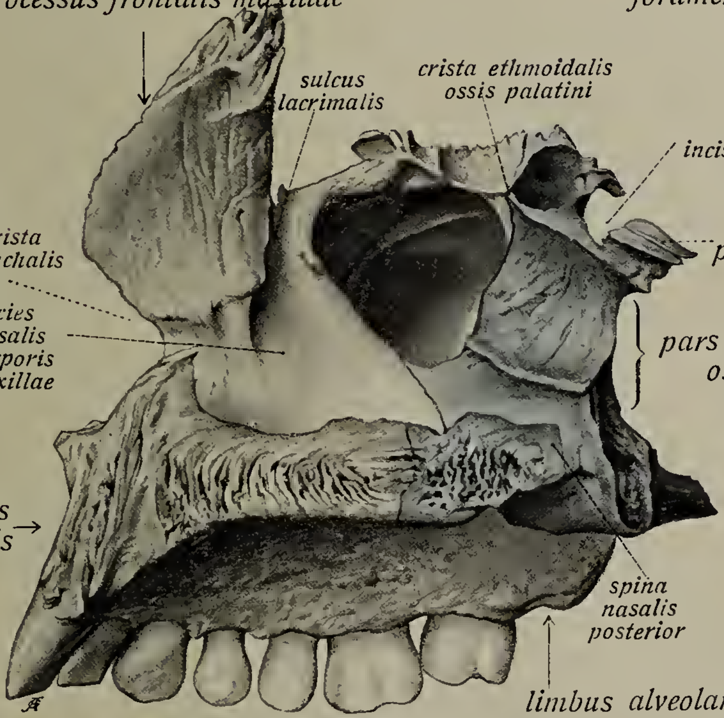
processus frontalis maxillae
sulcus lacrimalis
crista ethmoidalis ossis palatini
incisura sphenopalatina
processus sphenoidalis ossis palatini
crista chonchalis
facies nasalis corporis maxillae
pars perpendicularis ossis palatini
processus alveolaris
spina nasalis posterior
limbus alveolaris

Fig. 82.

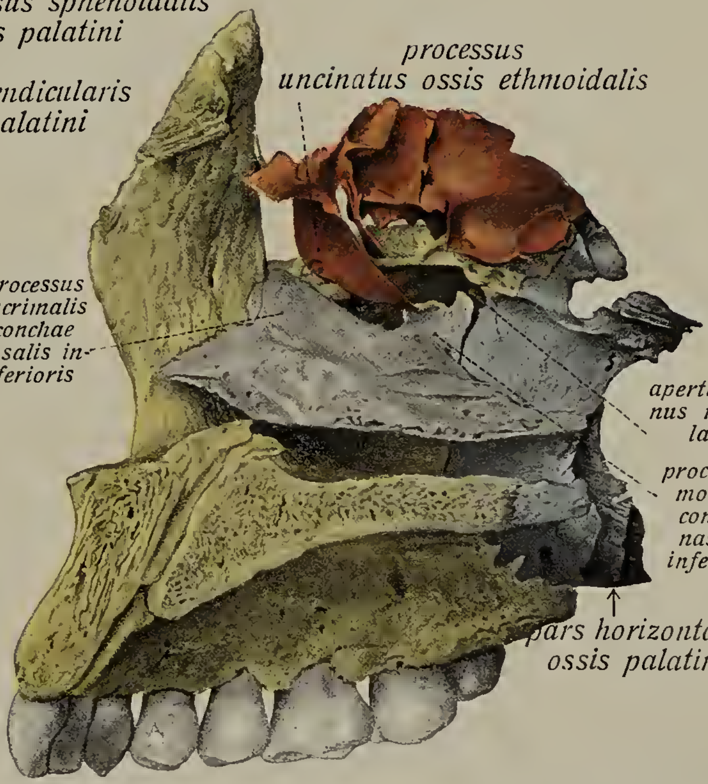
processus uncinatus ossis ethmoidalis
processus lacrimalis conchae nasalis inferioris
apertura sinus maxillaris
proc. ethmoidalis conchae nasalis inferioris
pars horizontalis ossis palatini

Fig. 83.

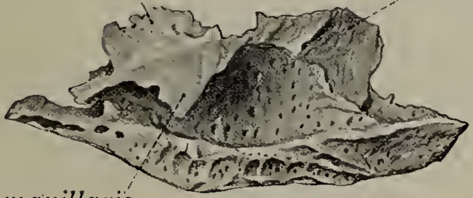

Fig. 84.

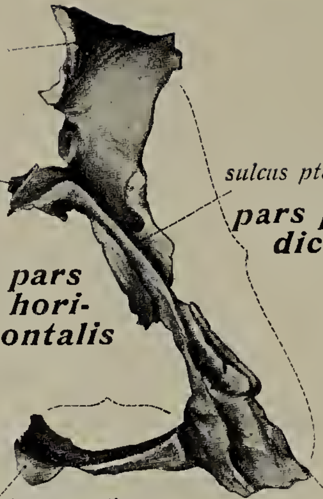

Fig. 85.

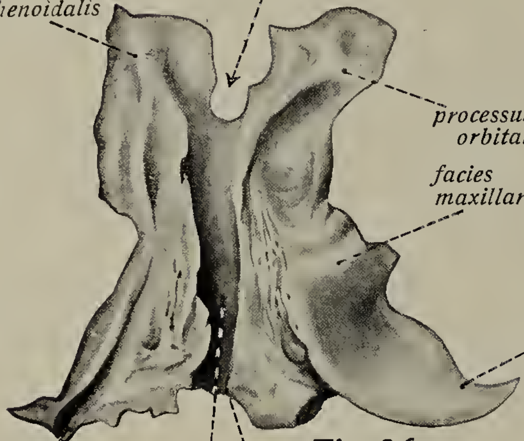

Fig. 86.

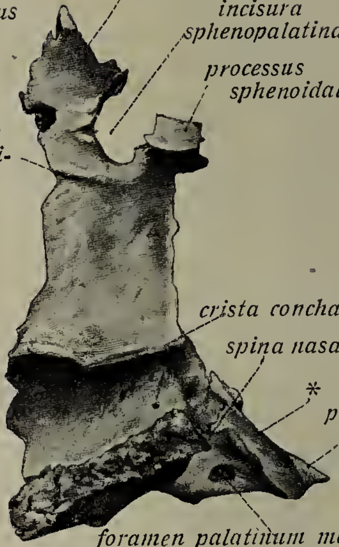

Fig. 87.

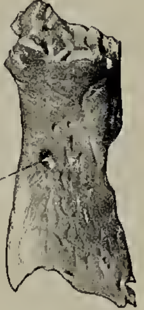

Fig. 88.

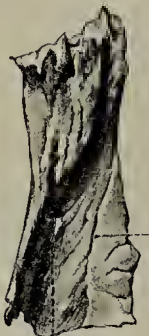

Fig. 89.

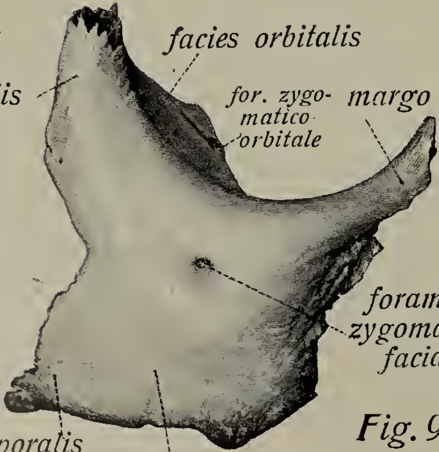

Fig. 90.

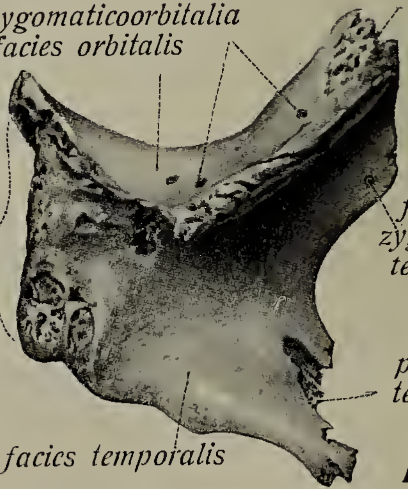
foramina zygomaticoorbitalia
facies orbitalis
processus frontosphenoidalis
[pro proc. zygomatic maxillae]
foramen zygomaticotemporale
processus temporalis
facies temporalis

Fig. 91.

The Palatine nasal and zygomatic Bones.

Fig. 85. The right palatine bone from behind. ($^1/_1$)
Fig. 86. The right palatine bone, lateral surface. ($^1/_1$)
Fig. 87. The right palatine bone, medial surface. ($^1/_1$)
* = place of articulation of the outer lamina of the pterygoid process.
Fig. 88. The left nasal bone from in front. ($^1/_1$)
Fig. 89. The left nasal bone from behind. ($^1/_1$)
Fig. 90. The right zygomatic bone, facial surface. ($^1/_1$)
Fig. 91. The right zygomatic bone, temporal surface. ($^1/_1$)

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ticular the palatine processes of the maxilla, from which they are separated by the transverse palatine suture. At the hinder end of the median palatine suture they form the posterior nasal spine and enclose on each side the *greater palatine foramen,* the anterior opening of the pterygo-palatine canal.

The *perpendicular portion* is narrower, but longer than the horizontal. Its *maxillary surface* overlies the posterior part of the nasal surface of the maxilla, while its *nasal surface* forms a part of the lateral wall of the nasal cavity. It bears two parallel, horizontal ridges, a lower stronger *conchal crest* for the inferior and an upper *ethmoidal crest* for the middle concha. Posteriorly it articulates with the pterygoid process of the sphenoid, its posterior border showing a furrow, the *pterygo-palatine* groove, which, with corresponding grooves on the pterygoid process and maxilla, forms the *pterygo-palatine canal.*

Three processes of the palatine bone are recognized. The *pyramidal process* is directed backwards and is short and broad. It fits into the pterygoid notch of the pterygoid process, completing the *pterygoid fossa.* It usually presents the posterior openings of the *lesser palatine foramina.* The *orbital* and *sphenoidal processes* arise from the upper border of the perpendicular portion and are separated by the *spheno-palatine notch.* The larger orbital process looks laterally and anteriorly, forms a small part of the floor of the orbit and articulates with the lamina papyracea of the ethmoid in the *palato-ethmoidal suture* and with the maxilla in the palato-maxillary suture, closing along these sutures the adjacent ethmoidal cells. The *sphenoidal process* is directed medially and posteriorly and articulates with the under surface of the body of the sphenoid. In addition the perpendicular portion gives origin at its base to a variable, but constant, process, the *maxillary process.* It is crescentic in shape and closes in, according to its size, a greater or less portion of the opening of the maxillary sinus, coming into relation with the maxillary process of the inferior concha (Fig. 86).

The **nasal bones** form a part of the bony arch of the nose. They are small, oblong bones, separated from each other by the *internasal suture.* They have a shorter medial and a longer lateral border, the latter articulating with the frontal process of the maxilla in the *naso-maxillary suture.* The upper and lower borders are irregular; the former articulates with the nasal portion of the frontal, the latter with the nasal cartilage. The posterior surface presents an *ethmoidal groove,* from which one or several *nasal foramina* pass to the outer surface of the bone.

The **zygomatic (malar) bone** is a rather thick triangular bone. Of its three surfaces the *malar* forms part of the face and is convex; it passes over into the zygomatic process of the maxilla and presents a *zygomatico-facial foramen.* The orbital surface is slightly concave and forms part of the lateral wall of the orbit; in half the cases it is a boundary of the anterior part of the inferior orbital fissure and presents one or two *zygomatico-orbital foramina.* The *temporal* surface is concave and presents the *zygomatico-temporal foramen.*

The bone has two processes. The *temporal process* projects horizontally backwards and articulates with the zygomatic process of the temporal to form the *zygomatic arch (zygoma).* The *fronto-sphenoidal process* is directed upwards to form part of the lateral wall of the orbit and articulates with the zygomatic process of the frontal and with the zygomatic border of the great wing of the sphenoid.

The Mandible.

Fig. 92. The mandible from in front. ($^1/_1$)
Fig. 93. The mandible from the left side. ($^1/_1$)

In the mandible there may be recognized a *body (corpus)* and two *rami.* The body is a thick curved plate from which the rami extend upwards almost at right angles.

The lower part of the mandible is termed the *base* and the tooth-bearing part the *alveolar portion.* The free border of the latter is termed the *limbus alveolaris* and bears the *dental alveoli,* separated from one another by *interalveolar septa;* it also presents *juga alveolaria* corresponding to the roots of the teeth. The outer surface of the body has in the middle line a roughened flat ridge, the *mandibular protuberance,* and lateral to this on the base on each side is a *mental tubercle* and further laterally the *mental foramen,* the anterior opening of the *mandibular canal* which traverses the bone. In addition there passes downwards upon the body from the anterior border of the ramus a smooth ridge which gradually diminishes in height and is termed the *oblique line.*

The inner surface of the body shows close to the middle line on each side a shallow *digastric fossa,* and between the two fossae and somewhat higher a sharp prominence, often doubled, the *mental spine.* Lateral to this is a distinct depression, the *sublingual fovea* for the sublingual gland and more laterally a much shallower, frequently indistinct, depression, the *submaxillary fovea* for the submaxillary gland. A rough line, beginning on the inner surface of each ramus, runs downwards and forwards upon the body, gradually becoming less distinct; it is the *mylohyoid line* and below it is a groove which extends downwards and forwards from the mandibular foramen, the *mylohyoid groove.*

Each *ramus* presents a medial surface, turned towards the oral cavity, and a lateral surface. Its lower posterior angle is termed the *angle* of the mandible. At about the middle of the medial surface is the *mandibular foramen,* which has a somewhat oblique position and opens into the mandibular canal; its inner border is raised into a projecting spine, the *lingula.* Above, each ramus divides into two processes separated by the mandibular notch. The anterior is the *coronoid process,* which is transversely flattened and sharp at its extremity; from its base a ridge, the *buccinator ridge,* extends to the neighbourhood of the last molar tooth. The posterior process is the *condyloid process.*

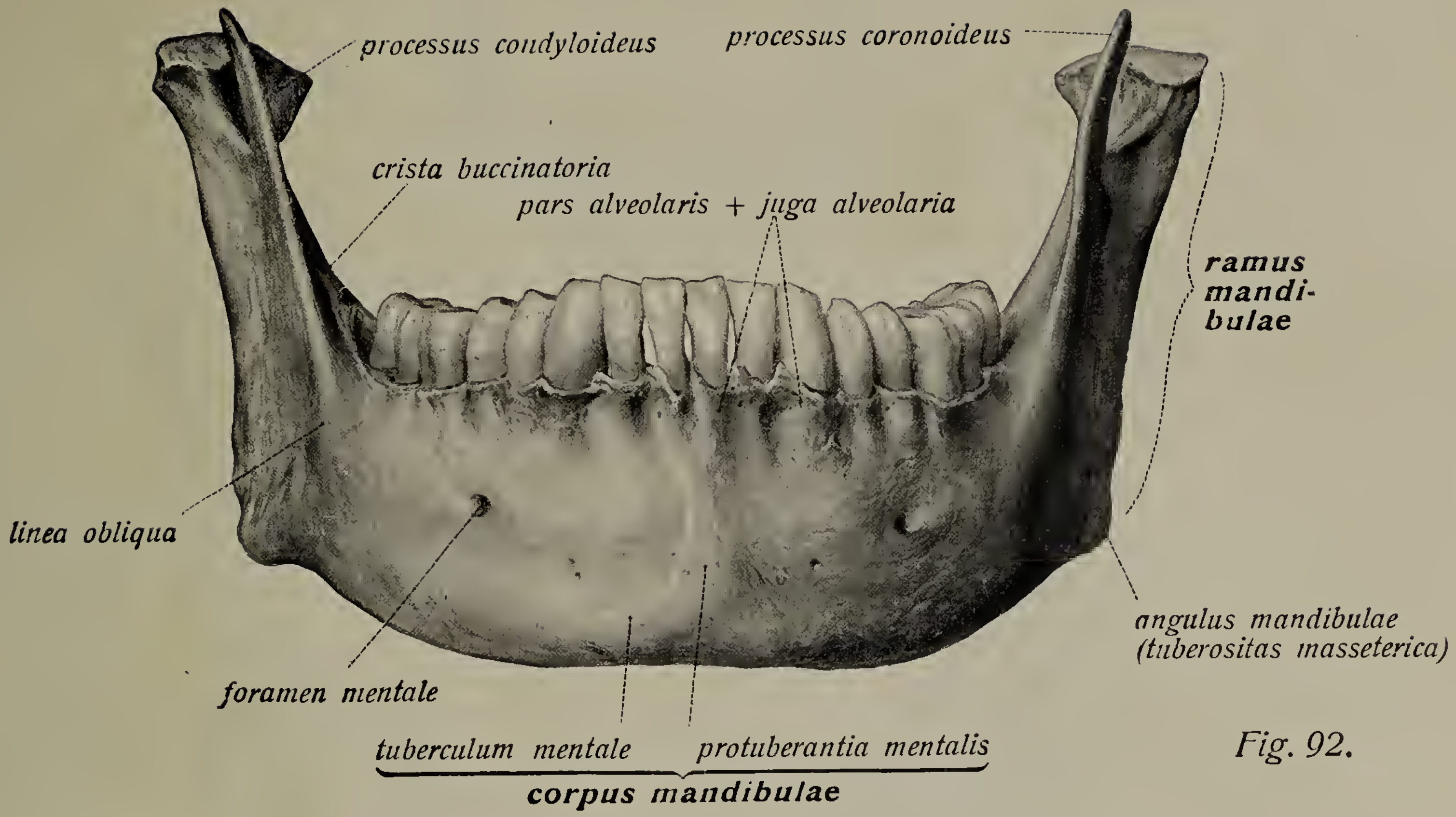
processus condyloideus
processus coronoideus
crista buccinatoria
pars alveolaris + juga alveolaria
ramus mandibulae
linea obliqua
angulus mandibulae (tuberositas masseterica)
foramen mentale
tuberculum mentale
protuberantia mentalis
corpus mandibulae

Fig. 92.

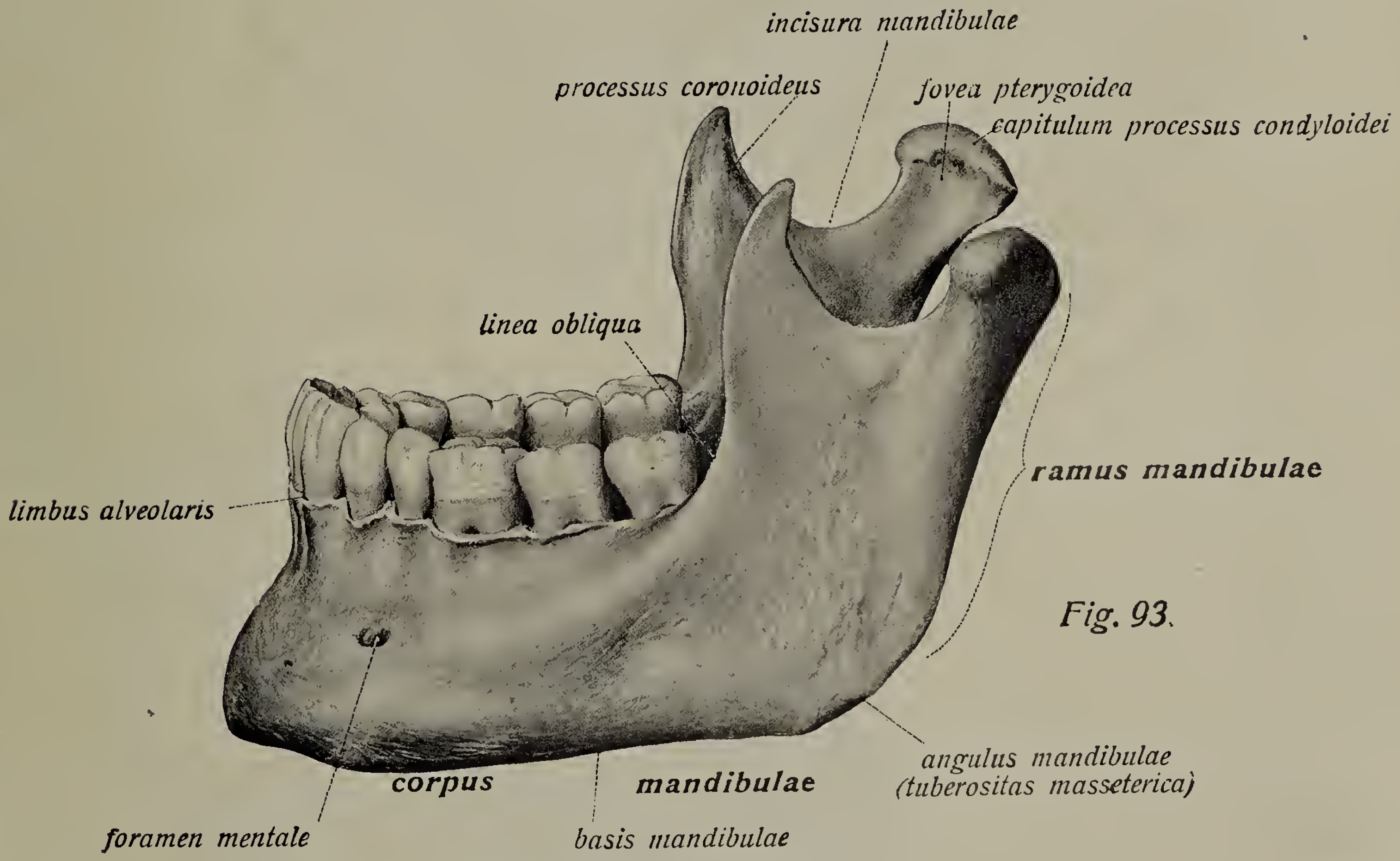
incisura mandibulae
processus coronoideus
fovea pterygoidea
capitulum processus condyloidei
linea obliqua
ramus mandibulae
limbus alveolaris
corpus
mandibulae
angulus mandibulae (tuberositas masseterica)
foramen mentale
basis mandibulae

Fig. 93.

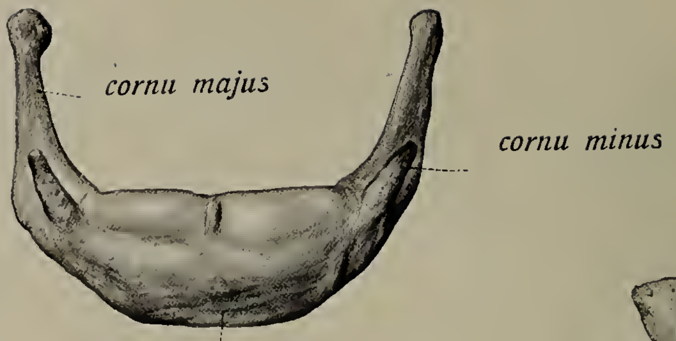

Fig. 96.

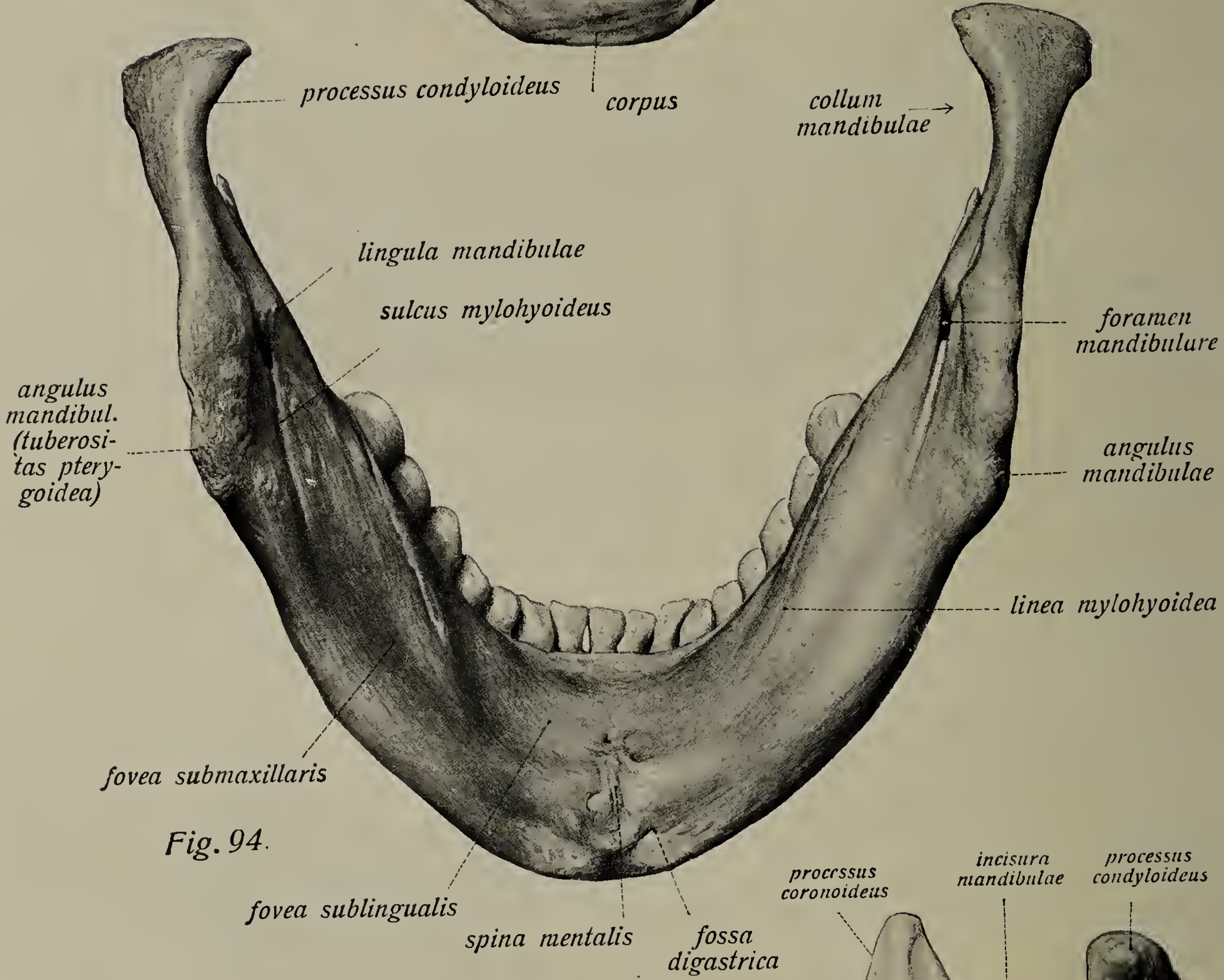

Fig. 94.

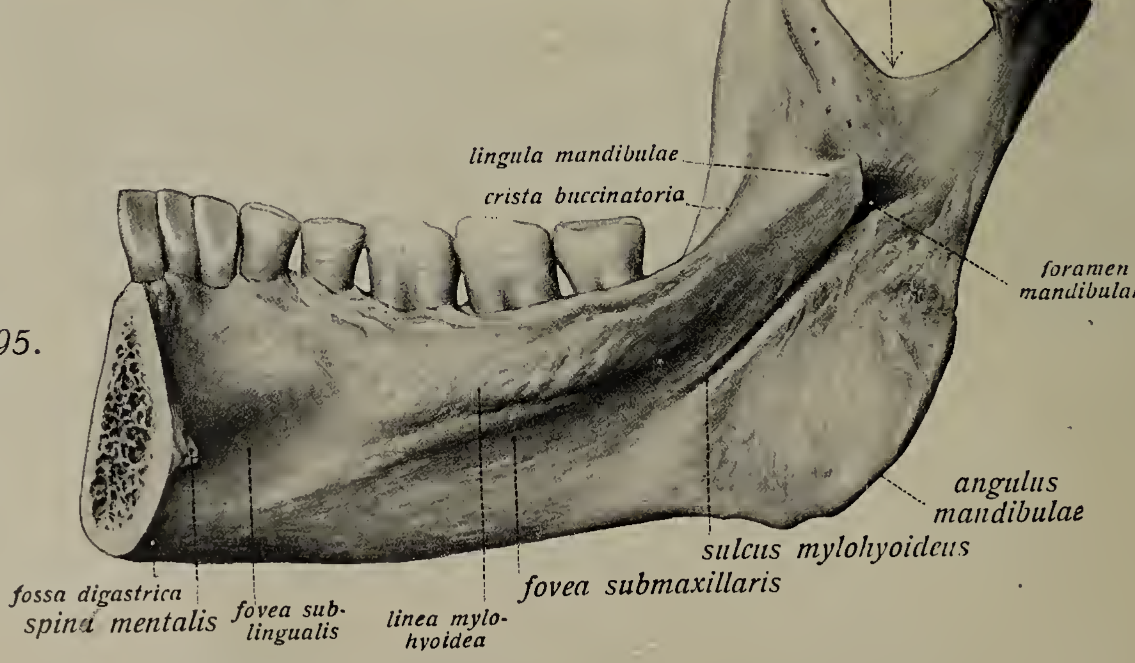

Fig. 95.

The Mandible and Hyoid Bone.

Fig. 94. The mandible from below. ($^1/_1$)
Fig. 95. The mandible divided in half from within. ($^1/_1$)
Fig. 96. The hyoid bone from in front and above. ($^1/_1$)

On the lateral surface of the angle of the mandible is the *masseteric tuberosity* and opposite it, on the medial surface, the *pterygoid tuberosity* for the attachment of similarly named muscles.

The *condyloid process* bears at its upper end a *head (capitulum)* with an articular surface for the mandibular fossa of the temporal bone. It has the shape of an almost transversely directed cylinder. The constriction below the head is termed the *neck (collum)* and a depression on the anterior surface of this is termed the *pterygoid fovea.*

The **hyoid bone** is a small, flat bone situated at the base of the tongue. Although it has no direct connection with the skull and is situated in the neck below the mandible, it is usually described as a cranial bone*). It presents a *body (corpus),* convex in front and concave behind, and two pairs of *cornua.* The greater *cornua* are long and thin and enlarged into a knob at their ends; they arise from the sides of the body, either by diarthroses, synchondroses or synostoses, and are directed upwards and backwards. The lesser *cornua* often remain cartilaginous, and are much smaller than the greater ones; they arise near the base of the greater ones and are directed posteriorly and laterally. They are usually united to the body by cartilage, rarely by a joint.

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*) The only connection of the hyoid bone with the skull is through the stylohyoid ligament which extends from the lesser cornus to the styloid process of the temporal and arises from the same embryological source as the hyoid.

The Orbit.

Fig. 97. The orbit from in front. ($^1/_1$)

Fig. 98. The medial wall of the orbit and pterygopalatine fossa. ($^1/_1$)

Fig. 99. The lateral wall of the orbit, the maxillary sinus and the pterygo-palatine fossa. ($^1/_1$)

In Figs. 97—99 the frontal bone is violet, the ethmoid orange, the maxilla yellow, the lacrimal red, the sphenoid green, the palatine blue and the nasal, parietal, temporal and zygomatic white.

The *orbit* is a paired cavity having the form of a four-sided pyramid placed horizontally, whose apex is formed by the optic foramen and its base is surrounded by the margins of the orbit, the *supraorbital* and *infraorbital.* The four sides of the pyramid form the orbital walls, one of which is *superior,* one *medial,* one *inferior* and one *lateral.* Seven bones enter into the boundaries of the orbit, the frontal, sphenoid, ethmoid, lacrimal, maxilla, zygomatic and palatine.

The *superior wall* is horizontal and slightly concave. It is formed partly by the orbital portion of the frontal and to a lesser extent posteriorly by the lesser wing of the sphenoid.

The *medial wall* is almost sagittal and is mainly formed by the lamina papyracea of the ethmoid and, in front of this, by the lacrimal. The *fronto-ethmoidal* and *fronto-lacrimal sutures* form the boundary between this and the upper wall. In addition the maxilla takes part in the formation of the medial wall, firstly, by the orbital surface of its body below the lamina papyracea and, secondly, by its frontal process, which forms a narrow strip of the medial wall adjacent to the lacrimal bone.

The *inferior wall* passes without any boundary into the medial, but in the posterior two-thirds of the orbit it is bounded laterally by the *inferior orbital fissure.* It is almost horizontal in position and is formed principally by the orbital surface of the maxilla and, to a small extent posteriorly, by the orbital process of the palatine.

The *lateral wall* is slightly concave and almost sagittal in position. It is more definitely bounded than the other walls in that in the whole of the hinder part of the orbit it is separated from adjacent walls by fissures. Between it and the upper wall is the *superior orbital fissure* and between it and the lower wall is the *inferior orbital fissure.* In its anterior part it is formed by the orbital surface of the zygomatic, in the posterior part by the orbital surface of the great wing of the sphenoid, the *spheno-zygomatic suture* separating these two surfaces.

The *supraorbital margin* is formed by the frontal bone, the *infraorbital margin* by the maxilla and zygomatic. The medial border is formed by the frontal process of the maxilla *(anterior lacrimal crest)* and the lateral border by the zygomatic.

The foramina and fissures in the orbit are: 1. the *optic foramen* in the lesser wing of the sphenoid; 2. the *superior orbital fissure* between the greater and lesser wings of the sphenoid; 3. the *inferior orbital fissure* between the maxilla (and palatine) on one side and the greater wing of the sphenoid on the other; 4. the upper opening of the *nasolacrimal canal;* 5. the *anterior* and *posterior* ethmoidal foramina in or near the fronto-ethmoidal suture; 6. the *zygomatico-orbital foramina* on the orbital surface of the zygomatic; 7. the *infraorbital canal* forming the continuation of the infraorbital groove on the orbital surface of the maxilla; 8. the *frontal* and *supraorbital notches* or *foramina* on the supraorbital margin.

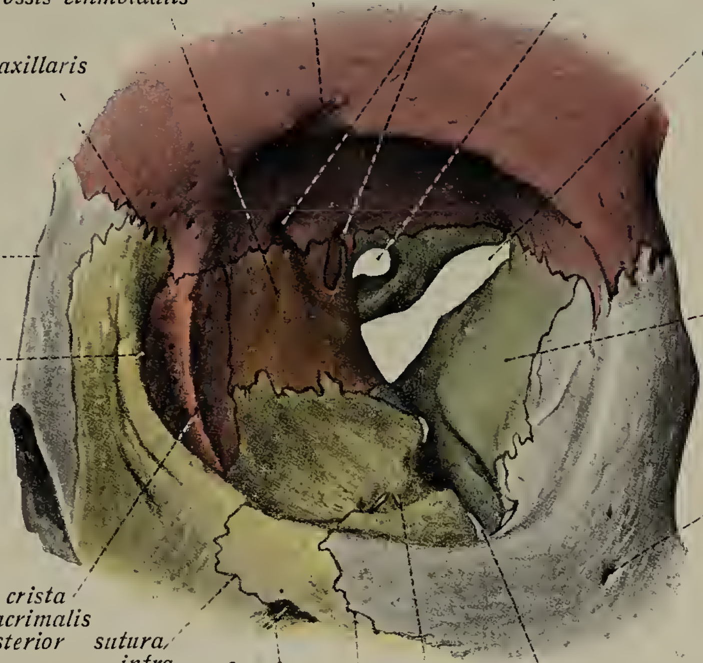

incisura supraorbitalis
foramina ethmoidalia (anter. + post.)
foramen opticum
lamina papyracea ossis ethmoidalis
fissura orbitalis superior
sutura frontomaxillaris
os nasale
facies orbital. alae magnae ossis sphenoidalis
crista lacrimalis anterior (processus frontalis maxillae)
for. zygomaticofaciale
crista lacrimalis posterior
sutura infraorbitalis
for. infraorbitale
sutura zygomaticomaxillaris
sulcus infraorbitalis
fissura orbitalis inferior

Fig. 97.

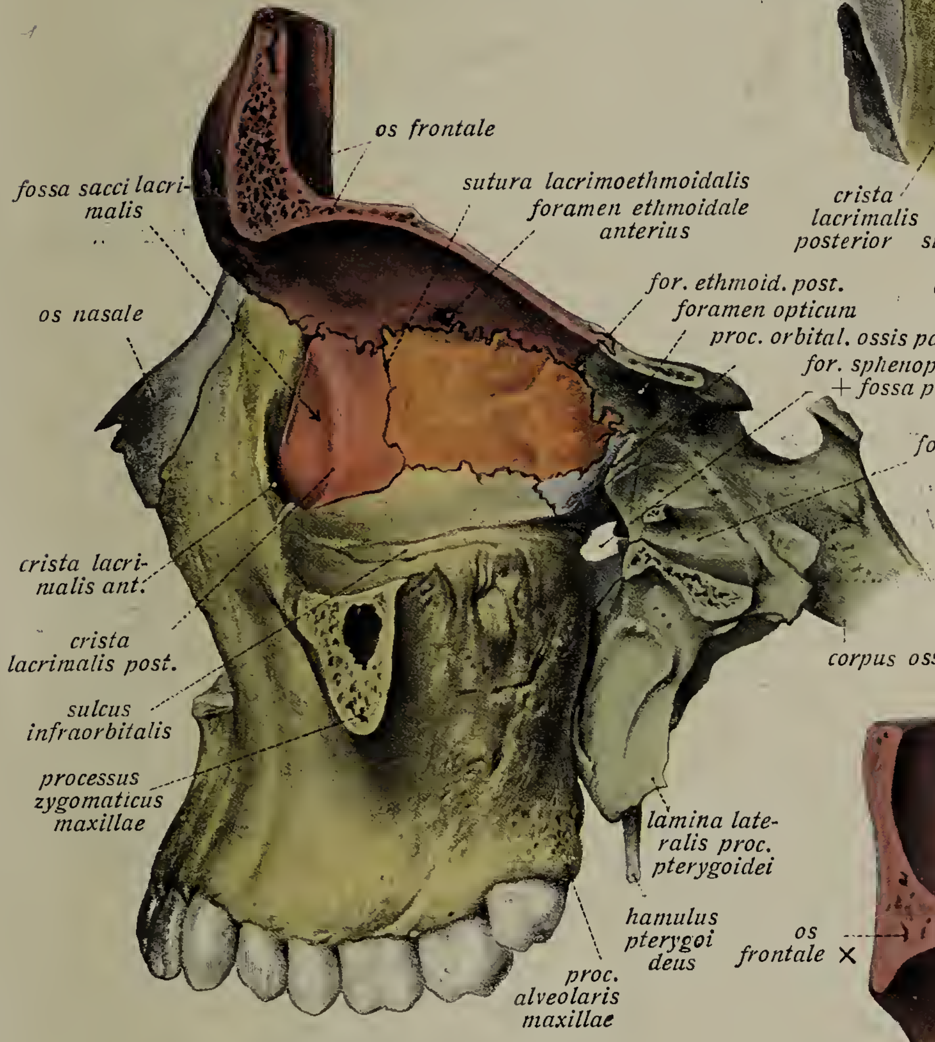

os frontale
fossa sacci lacrimalis
sutura lacrimoethmoidalis
foramen ethmoidale anterius
os nasale
for. ethmoid. post.
foramen opticum
proc. orbital. ossis palatini
for. sphenopalatinum + fossa pterygopalatina
foramen rotundum ×
crista lacrimalis ant.
crista lacrimalis post.
corpus ossis sphenoidalis
sulcus infraorbitalis
processus zygomaticus maxillae
lamina lateralis proc. pterygoidei
hamulus pterygoideus
proc. alveolaris maxillae

Fig. 98.

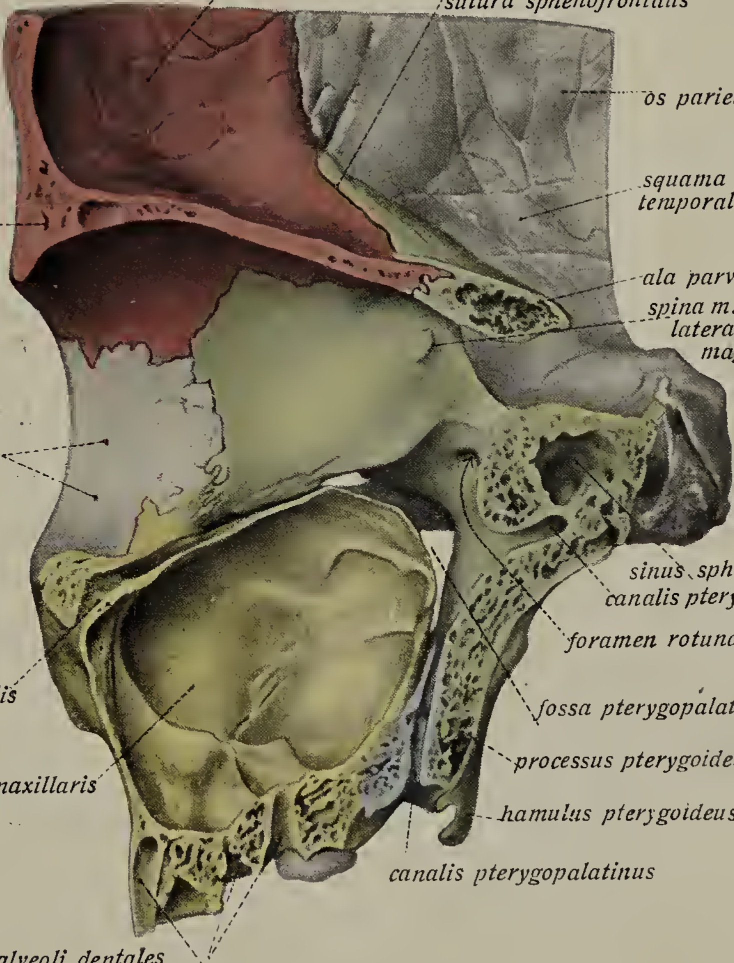


Fig. 99.

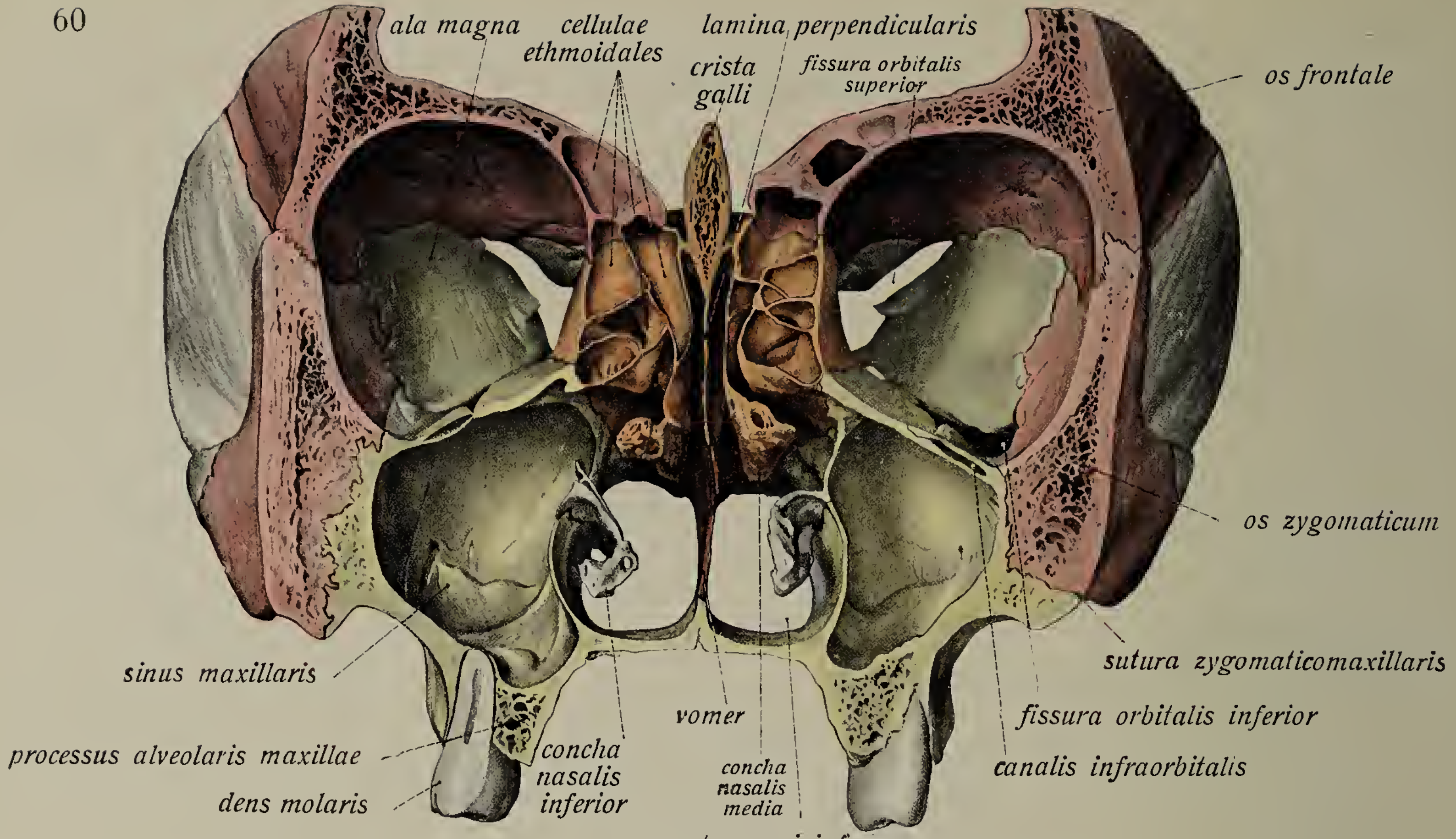


Fig. 100.

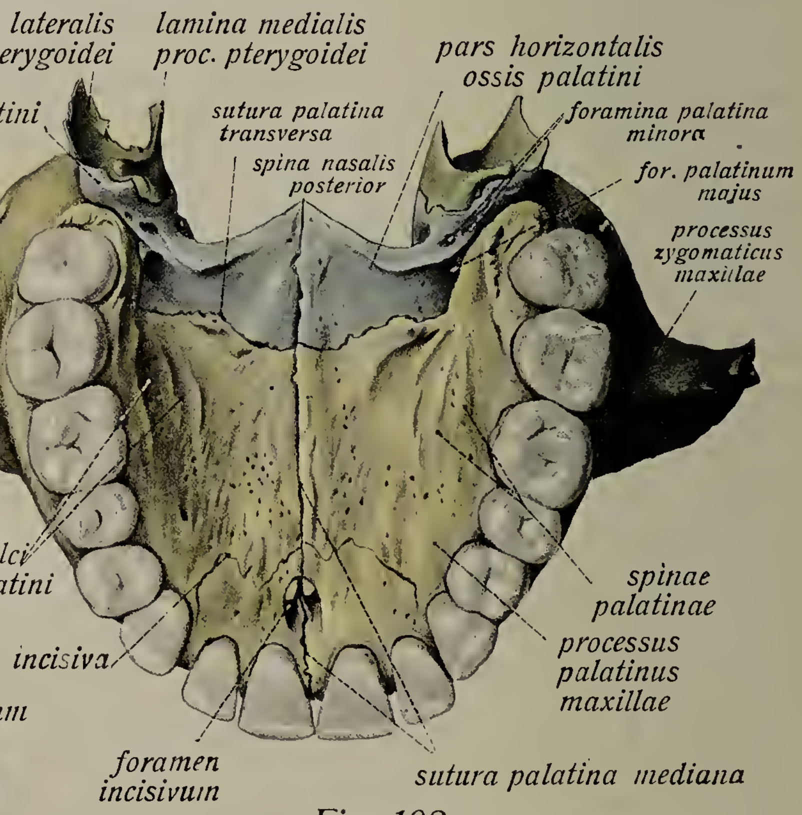

lamina lateralis proc. pterygoidei
lamina medialis proc. pterygoidei
pars horizontalis ossis palatini
proc. pyramidalis ossis palatini
sutura palatina transversa
spina nasalis posterior
foramina palatina minora
for. palatinum majus
processus zygomaticus maxillae
sulci palatini
spinae palatinae
sutura incisiva
processus palatinus maxillae
foramen incisivum
sutura palatina mediana

Fig. 102.

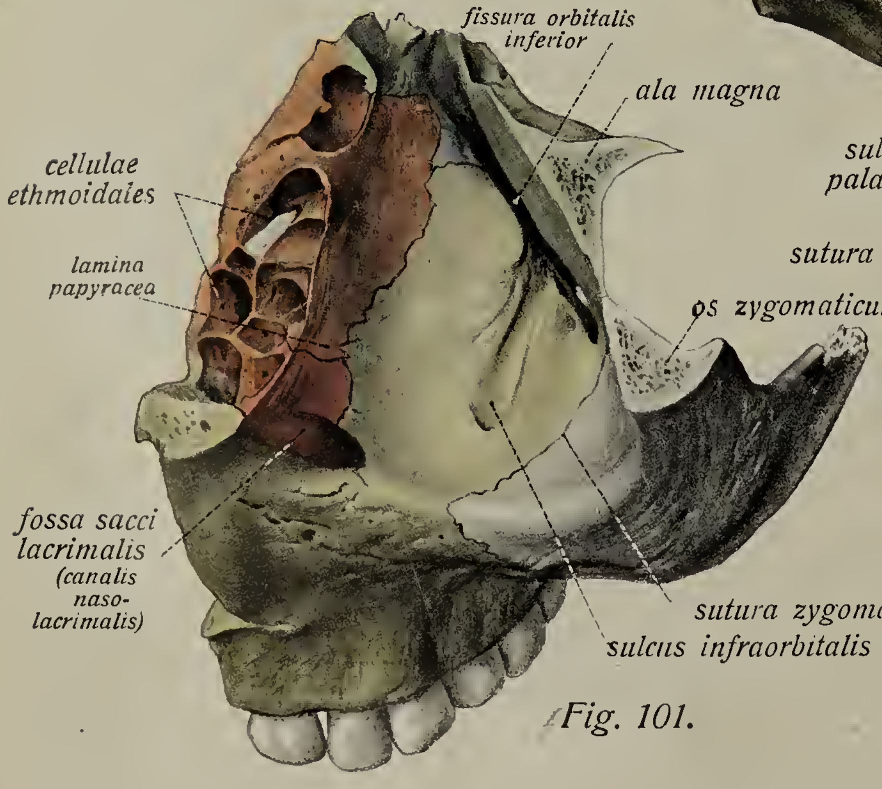

fissura orbitalis inferior
ala magna
cellulae ethmoidales
lamina papyracea
os zygomaticum
fossa sacci lacrimalis (canalis nasolacrimalis)
sutura zygomaticomaxillaris
sulcus infraorbitalis maxillae

Fig. 101.

The Orbit (Cont.), Hard Palate and Nasal Cavity.

Fig. 100. Frontal section through the anterior part of the skull, showing the orbit, nasal cavities, maxillary sinus and ethmoidal labyrinth. ($^4/_5$)
* = frontal sinus.

Fig. 101. Lower wall of the left orbit from above. ($^1/_1$)

Fig. 102. The maxilla with the palatine bone and lower ends of the pterygoid processes of the sphenoid from below. ($^1/_1$)

In Figs. 100—102 the frontal is violet, the ethmoid orange, the maxilla yellow, the sphenoid green, the palatine blue, the vomer and lacrimal red, the inferior concha and temporal white. The zygomatic is red in Fig. 100, white in Fig. 101.

In addition in the orbit, on the frontal bone, is the *trochlear fossa (sometimes a spine)* and the *fossa for the lacrimal gland;* in the region of the frontal process of the maxilla and the lacrimal bone, the *fossa for the lacrimal sac,* bounded by the anterior and posterior lacrimal crests; the *infraorbital groove* on the orbital surface of the maxilla; and the *spine for the rectus lateralis* on the great wing of the sphenoid.

The Hard Palate.

The *hard palate* forms the roof of the mouth cavity. It is an elongated, rounded quadrangular, strongly concave plate of bone, in whose formation the palatine processes of the maxilla and the horizontal portions of the palatines and partly also their pyramidal processes participate. It shows a *median palatine suture,* a *transverse palatine suture* and traces of an *incisive suture.* Anteriorly towards the front end of the median suture is the unpaired *incisive foramen,* by which the bony oral cavity communicates with both nasal cavities. Posteriorly in the horizontal portion of the palatine bone there is, on either side, the *greater palatine foramen* and in each pyramidal process the lesser *palatine foramen.* These paired foramina are the openings of the *pterygo-palatine canal.*

The Nasal Cavity.

The bony nasal cavity is unpaired, but is divided into two symmetrical cavities by a median partition, the *nasal septum,* which is often oblique or not quite in the median line. Nine bones take part in the formation of the cavity; the nasal, frontal, ethmoid, sphenoid, maxilla, palatine, inferior concha, vomer and lacrimal. Its anterior opening is the *piriform aperture,* its posterior the *choanae.* The former is bounded by the nasal bones, the frontal processes and bodies of the maxilla; the choanae by the palatine bones, the medial plates of the pterygoid processes and the body of the sphenoid. The roof of the cavity is formed anteriorly by the two nasal bones and the nasal portions of the frontals, in the middle by the lamina cribrosa of the ethmoid and, posteriorly, by the body of the sphenoid. Its floor is the upper surface of the hard palate and is formed by the palatine processes of the maxillae and the horizontal portions of the palatine bones.

The Nasal Cavity (Cont.) and the Pterygo-palatine Fossa.

Fig. 103. The right lateral wall of the nasal cavity. ($^4/_5$) (after removal of the septum nasi).

Fig. 104. The same, except that the middle concha has been cut away; the upper concha was hardly indicated. ($^4/_5$)

Fig. 105. The left pterygo-palatine fossa from the side, exposed by removing the zygomatic bone. ($^4/_5$)

In Fig. 103—105 the frontal is violet, the lacrimal red, the ethmoid orange, the maxilla yellow, the palatine blue, the sphenoid green and the other bones white. In Fig. 103 the parietal is brown and in Fig. 104 the ala of the vomer is red.

* = the opening of the frontal sinus in the hiatus semilunaris.

The *nasal septum* forms the medial wall for each nasal cavity and is itself formed by the lamina perpendicularis of the ethmoid anteriorly and posteriorly and below by the vomer (see Fig. 72); the remaining portion is cartilaginous (see Vol. II).

The lateral wall of each cavity bears three *nasal conchae*. The lowest is a distinct bone, the *inferior nasal concha*, and is the largest and longest of the three, the uppermost being the smallest and shortest. The middle and upper conchae are projections of the ethmoid bone. By these three conchae the lateral portion of each cavity is divided into three passages (meatus); the *superior meatus* is between the superior and middle concha, the *middle meatus* between the middle and inferior and the *inferior meatus* between the inferior concha and the floor of the cavity. Above the superior concha there is a groove-like depression, the *spheno-ethmoidal recess*. The part of the cavity medial to the conchae, between their medial edges and the septum, is termed the *common meatus*, the part behind the posterior ends of the concha the *nasopharyngeal meatus*. The following bones take part in the formation of the lateral wall; the ethmoid above and behind, the nasal surface of the frontal process of the maxilla above and in front, the body of the same bone below and in front, the perpendicular portion of the palatine behind and the medial surface of the lacrimal, which forms a small part in the anterior portion of the middle meatus. In addition to the principal nasal cavities there is a number of accessory cavities, which are air-containing, in most of the skull bones and especially those of the maxilla, the frontal, the sphenoid and the ethmoid. The openings into the nasal cavities are also numerous and are: 1. in the roof, the foramina of the lamina cribrosa of the ethmoid; 2. in the floor, the upper openings of the incisive canal on each side of the nasal crest; 3. in the inferior meatus, the inferior opening of the *nasolacrimal canal;* 4. in the middle meatus, in the neighbourhood of the *infundibulum*, the opening of the frontal sinus by the *hiatus semilunaris*, that of the sinus maxillaris and the openings of the anterior ethmoid cells; 5. in the upper meatus, the openings of the middle and posterior ethmoidal cells; and 6. in the upper posterior part of the nasal cavity, the opening of the sphenoidal sinus, the small *posterior ethmoidal foramen* and the large, round *spheno-palatine* foramen.

The Pterygo-palatine Fossa.

The small *pterygo-palatine fossa* is situated between the anterior surface of the pterygoid process of the sphenoid, the perpendicular part of the palatine and the posterior end of the maxilla. It is funnel-shaped and passes below, without any demarcation, into the *pterygoid canal*, bounded by the same three bones. Above it opens into the *inferior orbital fissure* and laterally by the *pterygo-maxillary fissure* into the *infratemporal fossa*. Into it there are three openings; the foramen rotundum leading from the skull cavity, the opening of the horizontal pterygoid canal, which passes backward in the root of the pterygoid process to the foramen lacerum, and the *spheno-palatine foramen* leading into the nasal cavity.

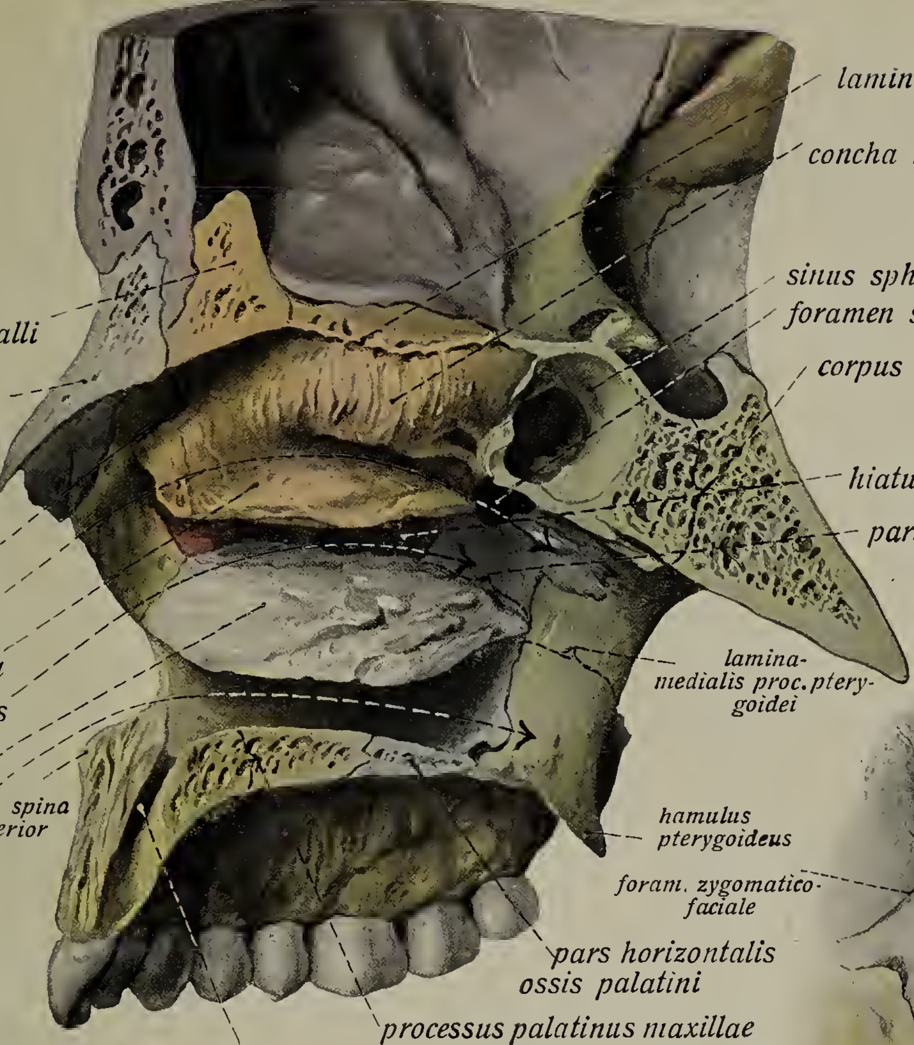


Fig. 103.

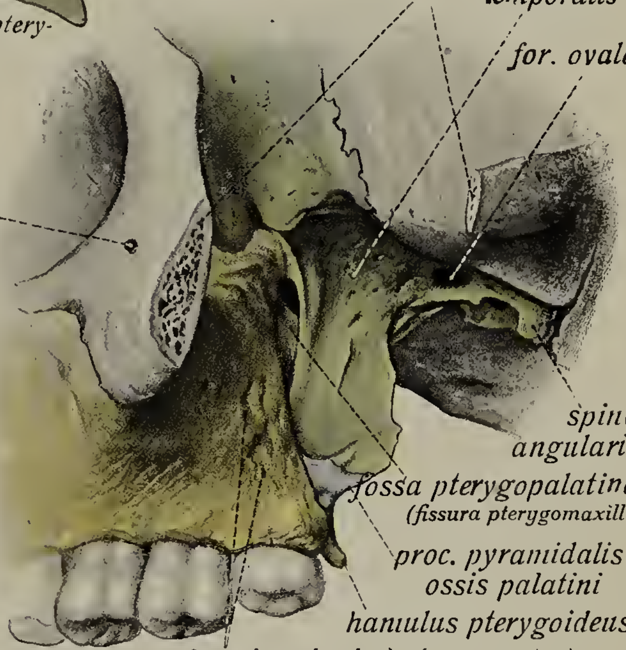

arcus zygomaticus ×
fossa infratemporalis
for. ovale
foram. zygomaticofaciale
spina angularis
fossa pterygopalatina (fissura pterygomaxill).
proc. pyramidalis ossis palatini
hamulus pterygoideus
foramina alveolaria (super. poster.)

Fig. 105.

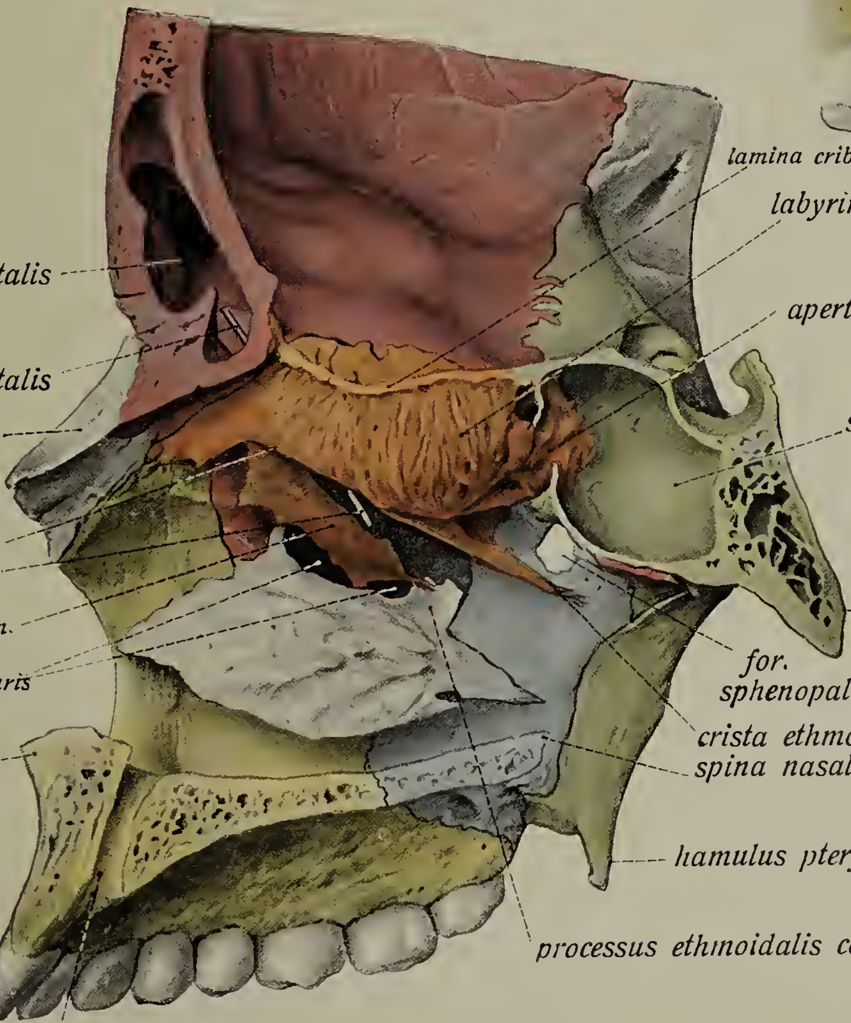


Fig. 104.

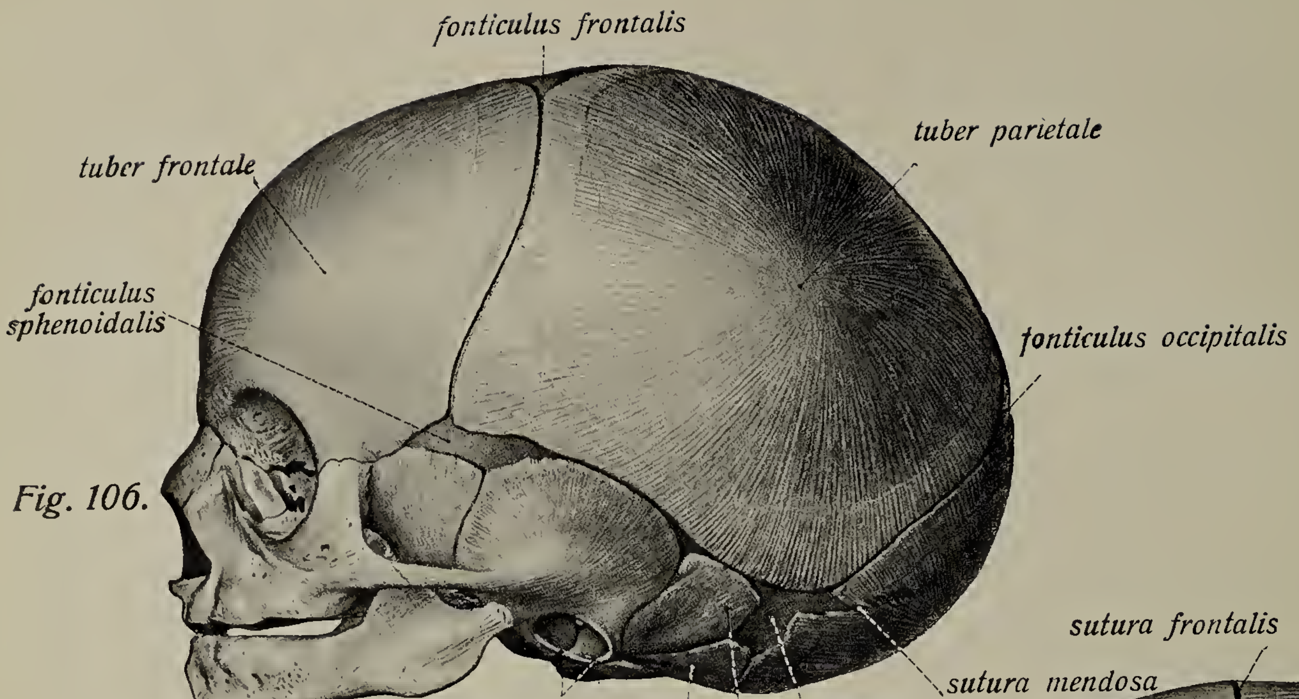


Fig. 106.

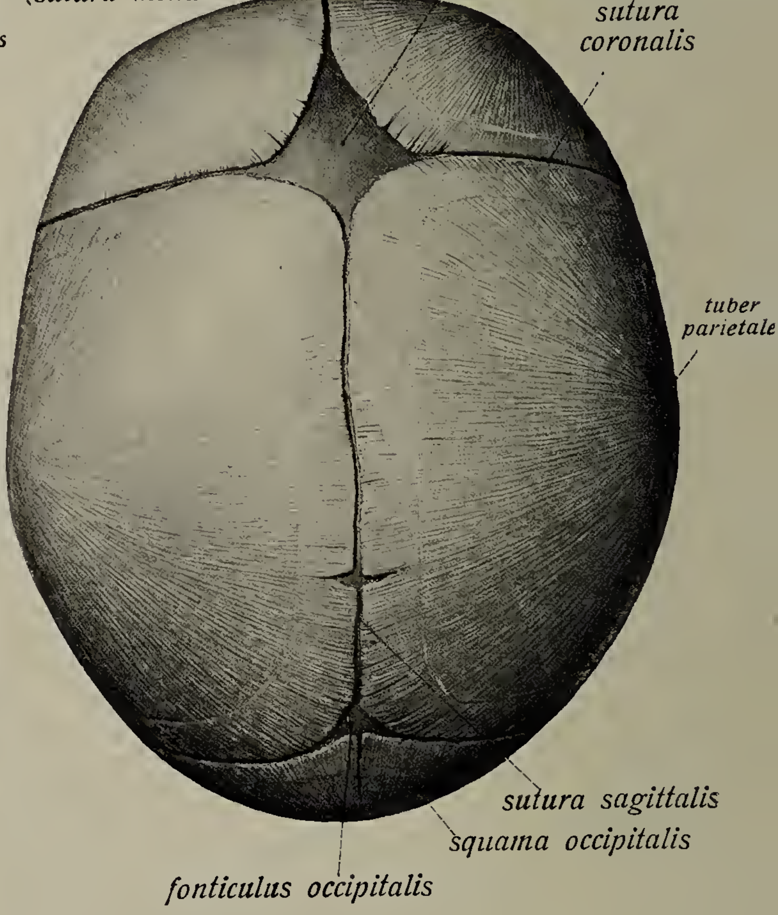


Fig. 107.

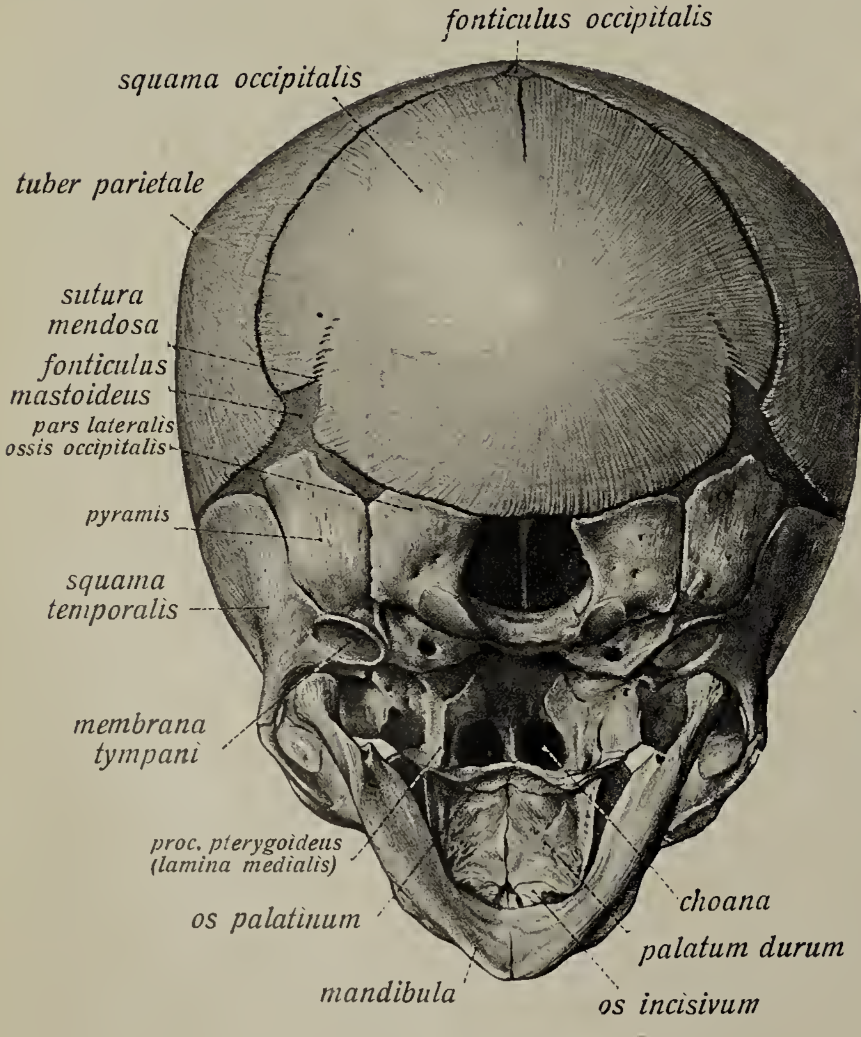


Fig. 108.

The Skull of the New Born Child.

Fig. 106. The skull of a new-born child from the side. ($^3/_4$)
Fig. 107. The skull of a new-born child from above. ($^3/_4$)
Fig. 108. The skull of a new-born child from behind and below. ($^3/_4$)

The skull of the new-born child differs in many points from that of the adult. Instead of meeting in sutures the bones of the vault of the skull are connected by membrane, which in several places forms *fontanelles (fonticuli).* There are of these two unpaired and two paired.

The *frontal* or *great fontanelle (fonticulus frontalis)* is rhomboidal in shape and lies at the meeting of the frontal, coronal and sagittal sutures, that is to say, between the two halves of the frontal bone, separated by a frontal suture, and the two parietals.

The *occipital* or *lesser fontanelle (fonticulus occipitalis)* is triangular and lies at the hinder end of the sagittal suture, between the two parietal bones and the occipital.

The *sphenoidal fontanelles (fonticuli sphenoidales)* are irregularly quadrangular and lie on each side between the sphenoidal angle of the parietal bone and the parietal angle of the great wing of the sphenoid, where later is the spheno-parietal suture.

The *mastoid fontanelles (fonticuli mastoidei)* are, like the sphenoidal, of irregular shape and lie on either side between the mastoid angle of the parietal and the mastoid portion of the temporal, where later is the parieto-mastoid suture.

The squamous portion of the occipital shows a *sutura mendosa,* and the bone is represented by four distinct portions, the squamous, two lateral and basilar portions, separated by *anterior* and *posterior intraoccipital synchondroses.* In the temporal bone in place of the tympanic portion there is the *anulus tympanicus* (see p. 39); the mastoid process is completely absent and the *squamoso-mastoid suture* separates the squamous portion from the pyramid, i. e. from the petrous portion and the mastoid. On the parietal the tuberosity is very distinct, as is also that of the frontal bone, which is still in two portions separated by the *frontal suture.* Between the sphenoid and the occipital there is a *spheno-occipital synchondrosis* and in the body of the sphenoid an *intersphenoidal synchondrosis.*

The maxilla and mandible are low, the alveolar portions being quite wanting. The incisive suture is quite distinct on the hard palate. Between the two halves of the mandible the remains of a suture are visible; the rami are almost in the same line as the body, i. e. they form with it a very obtuse angle.

C. The Appendicular Skeleton.

The Skeleton of the Left Upper Extremity.

The Left Shoulder Girdle.

The girdle of the upper extremity is formed of two bones, the *scapula* and the *clavicle.*

The Scapula.

Fig. 110. The dorsal surface of the left scapula. $(^1/_2)$
Fig. 111. The costal surface of the left scapula. $(^1/_2)$

The *scapula* is a typical flat bone of triangular shape. Its anterior surface, turned toward the ribs, is termed the *costal surface,* its posterior surface, the *dorsal surface.* Its three angles are termed *medial, inferior* and *lateral* and its three borders, the *superior, vertebral* or medial and *axillary* or lateral.

The *costal surface* is smooth except for some transverse lines, *lineae musculares,* for the attachment of the subscapular muscle, and it is slightly concave, forming the *subscapular fossa* for the muscle of that name.

The *dorsal surface* is divided into two areas by a strong, roughened ridge the *spine;* the upper smaller area is the *supraspinous fossa* and the lower larger one the *infraspinous fossa,* which lodge muscles of the same names. The *spine* of the scapula is flat at the vertebral border, but becomes higher as it passes transversely across the dorsal surface, and at the neck of the bone it is prolonged into a flattened process, projecting over the lateral angle and termed the *acromion.* It presents a small surface for articulation with the clavicle *(facies articularis).*

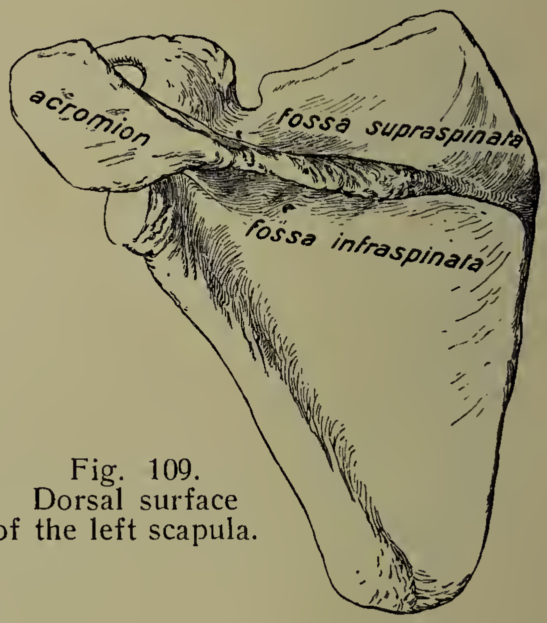


Fig. 109.
Dorsal surface
of the left scapula.

The *vertebral border* is usually slightly and obtusely angled at the base of the spine; the *axillary border* is thick and rough for the attachment of muscles. The *superior border* presents a notch in the neighborhood of the lateral angle, the *scapular notch,* and between the notch and the lateral angle it gives rise to a strong hook-shaped *coracoid process.* This arises by a broad base and is at first directed upwards, but then bends forward and laterally.

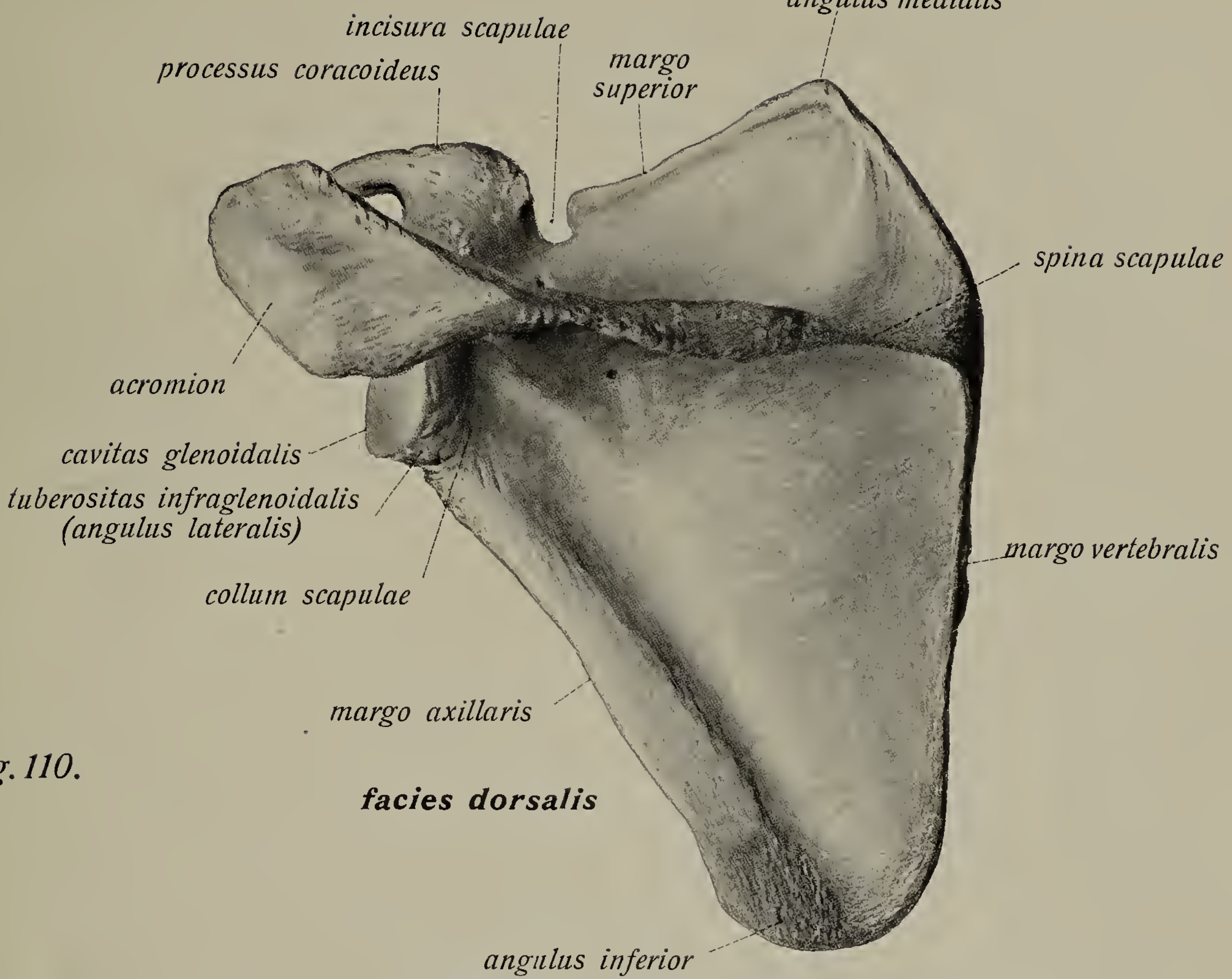
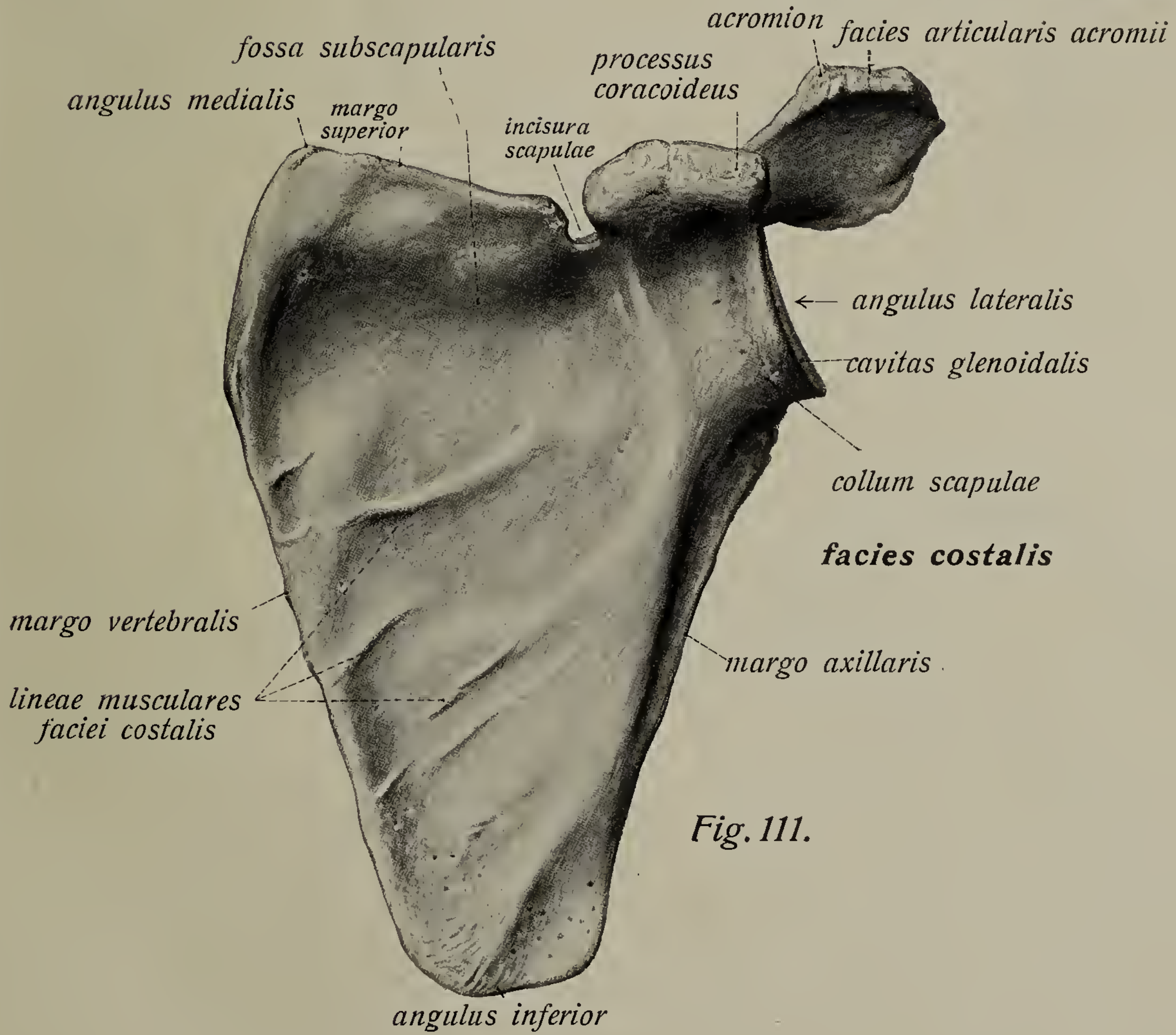


Fig. 110.

facies dorsalis



facies costalis

Fig. 111.

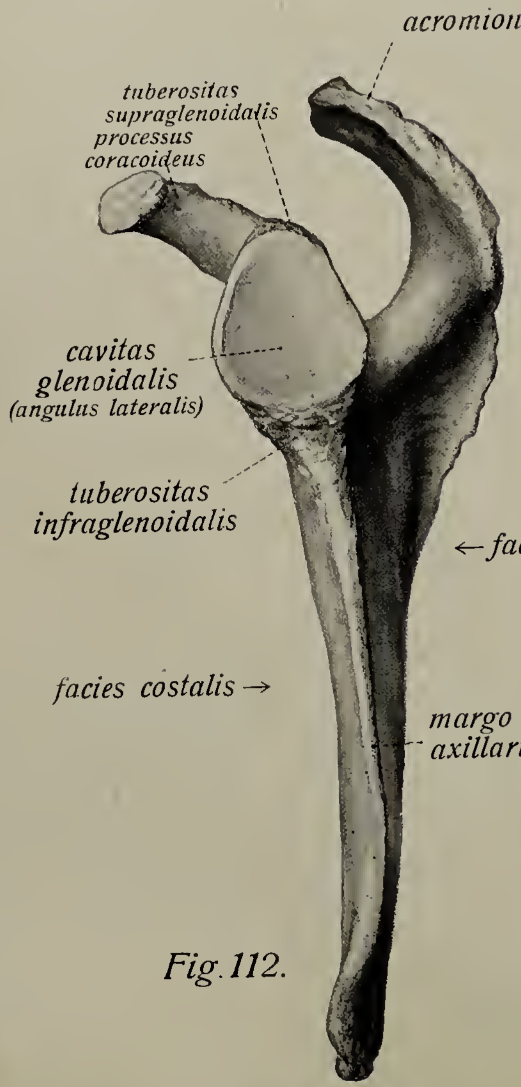

acromion
tuberositas supraglenoidalis
processus coracoideus
cavitas glenoidalis (angulus lateralis)
tuberositas infraglenoidalis
← facies dorsalis
facies costalis →
margo axillaris

Fig. 112.

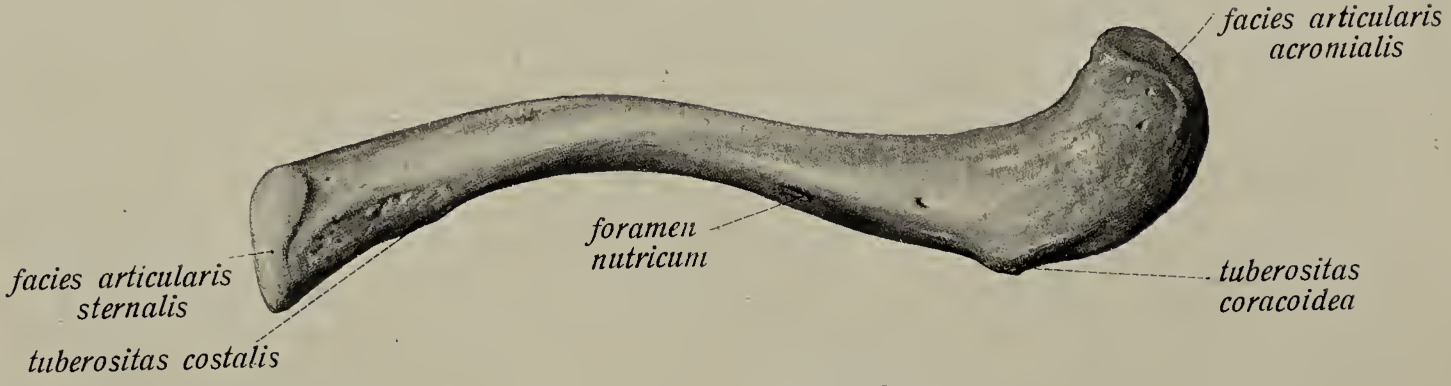


Fig. 113.

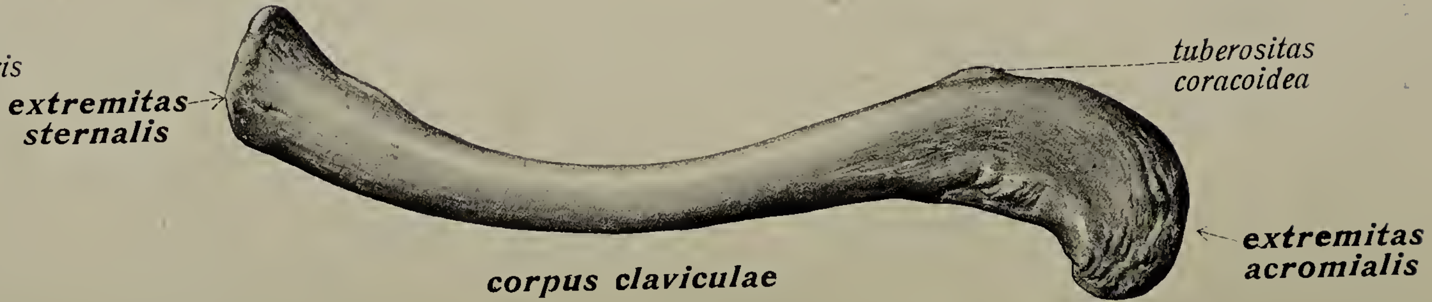


Fig. 114.

The Scapula (Cont.) and Clavicle.

The *lateral angle* bears the pear-shaped, slightly concave *glenoid cavity* for the reception of the head of the humerus. Both above and below it is a roughened area, the *supraglenoid* and *infraglenoid tuberosities,* which give origin to the tendons of the long heads of the biceps and triceps. The constriction of the scapula medial to the borders of the glenoid cavity is called the *neck (collum)* and in this region the supraspinous and infraspinous fossae become continuous. The medial angle is a right angle, the inferior one is more acute, but strongly rounded.

The Clavicle.

The *clavicle* is an S-shaped, long bone in which a middle portion, the *body (corpus)* and two extremities may be recognized; of the latter the medial is termed the *sternal* and the lateral the *acromial extremity* after the bones with which they articulate. The bone is convex anteriorly at its sternal extremity and concave anteriorly at its acromial extremity. The sternal end is thick and almost triangular-prismatic; the acromial end on the contrary is flattened.

At the sternal end there is a triangular *sternal articular surface,* which forms part of the sterno-clavicular articulation. Lateral from this on the anterior, lower border is a roughened area. the *costal tuberosity,* for the attachment of the costo-clavicular ligament. The body of the bone, like the sternal extremity, is almost triangular, but with strongly rounded angles.

The flattened acromial extremity at its boundary with the body and at its posterior and lower border bears a roughened area, the *coracoid tuberosity,* for the attachment of the coraco-clavicular ligament and, at its very end, an *acromial articular surface* for articulation with the acromion.

Fig. 112. The left scapula seen from the lateral angle and axillary border. (${}^{1}/_{2}$)

Fig. 113. The left clavicle from below. (${}^{2}/_{3}$)

Fig. 114. The left clavicle from above. (${}^{2}/_{3}$)

The Skeleton of the Left Free Upper Extremity.

The Humerus.

Fig. 115. The left humerus from behind. ($^1/_2$)

Fig. 116. The left humerus from in front. ($^1/_2$)

Fig. 117. The head of the humerus from above. ($^4/_5$)

1 = facet for the supraspinatus, 2 = facet for the infraspinatus, 3 = facet for the teres minor.

Fig. 118. The lower end of the humerus from below. ($^4/_5$)

The *humerus* is a typical long bone, in which may be distinguished a long shaft or *body (corpus)* and two thickened extremities, superior and inferior. The *superior extremity* bears an articular *head (caput),* placed at an angle with the body and directed medially. It is almost hemispherical and is separated from the shaft of the bone by a shallow, circular groove, the *anatomical neck (collum anatomicum).* In addition to the head, the upper extremity bears two roughened elevations for muscular attachment; a larger one, the *greater tubercle* directed laterally, and a smaller one, the *lesser tubercle,* directed medially and anteriorly. Between the two is a distinct *intertubercular groove.* At the junction of the upper extremity with the body, below the tubercles, there is a distinct diminution of the diameter of the bone, termed the *surgical neck (collum chirurgicum).*

The upper end of the shaft is almost cylindrical, but below the middle it becomes somewhat triangular and, at the same time, flattened. From each tubercle a ridge *(crista)* passes downwards, continuing the intertubercular groove for some distance. Below the greater tubercular crest there is a large, flat, roughened area the *deltoid tuberosity,* for the attachment of the deltoid muscle; it is on the lateral, posterior part of the bone, which, at this level, is still cylindrical. At about the middle of the shaft on its medial surface there is a roughened area, not always distinct, for the attachment of the coraco-brachialis muscle and near this there is a frequently large *nutritive foramen.*

From the middle of its length downwards the shaft of the humerus presents three surfaces, *lateral, anterior medial,* and *anterior lateral.* The two anterior surfaces are separated by a low elevation, but at the lateral angles there are sharp borders, *medial* and *lateral.* The lateral border begins below the deltoid tuberosity, being separated from it by a shallow groove, the *groove for the radial nerve (musculo-spiral groove).* This contains the radial (musculospiral) nerve and winds around the middle portion of the shaft in an open spiral, passing from above and medially, downwards and laterally and gradually flattening out. Its borders serve for the attachment of two heads of the triceps muscle. Towards the inferior extremity the humerus becomes markedly flattened and at the same time broader. The two borders are continued into two rough muscle projections, the medial border into the strongly projecting *medial epicondyle* and the sharper lateral border into the smaller *lateral epicondyle.* The former has on its posterior surface a shallow *groove for the ulnar nerve,* which is bounded laterally by the border of the trochlea.

Below the epicondyles is the lower articular head of the humerus, for the bones of the forearm. There is a separate surface for each of these, the large *trochlea,* hour-glass shaped, on the medial side for the ulna and the smaller, hemispherical *capitulum* laterally, for the radius. Above the trochlea on the medial anterior surface there is at the level of the epicondyle a rather deep depression, the *coronoid fossa,* and above the capitulum at the lower part of the lateral anterior surface there is a much smaller and shallower one for the head of the radius. Opposite these two fossae there is on the lower part of the posterior surface a broad and deep *olecranal fossa.*

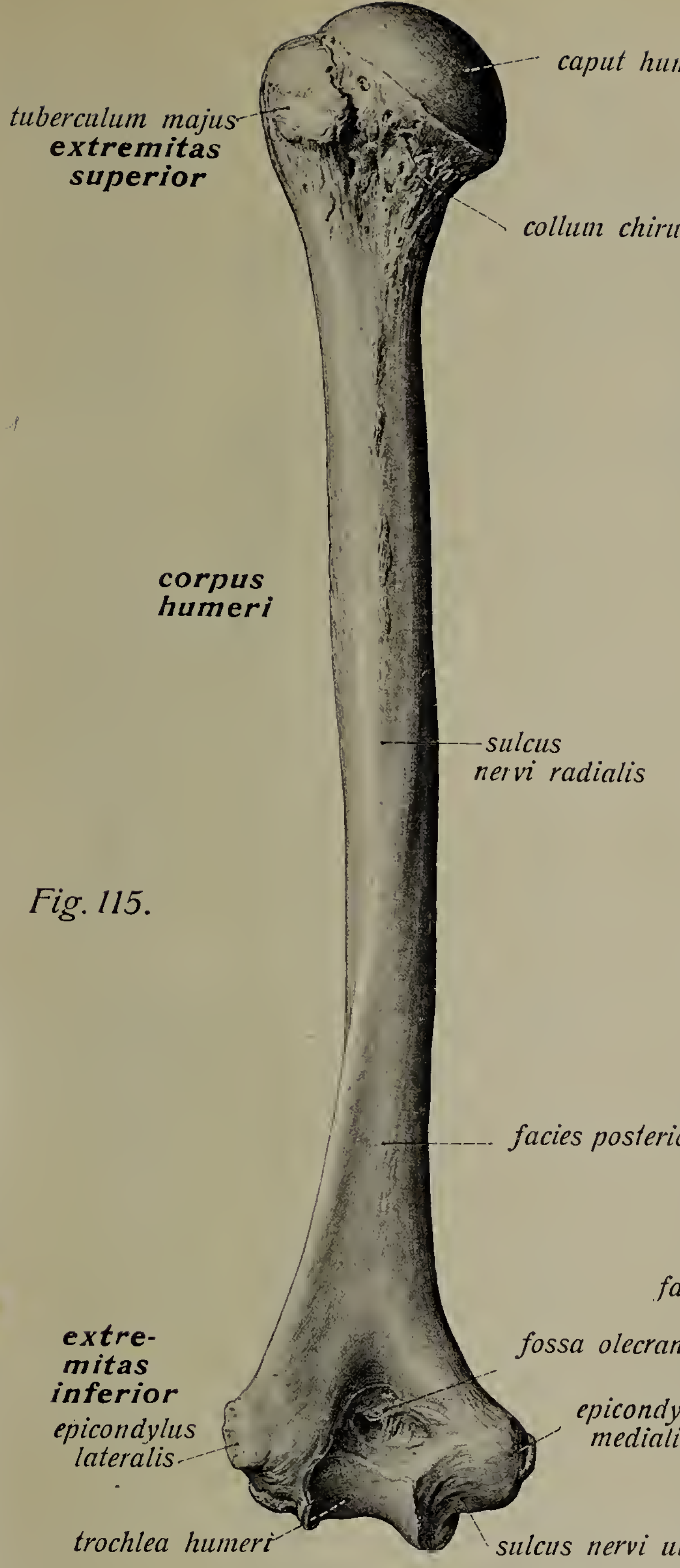
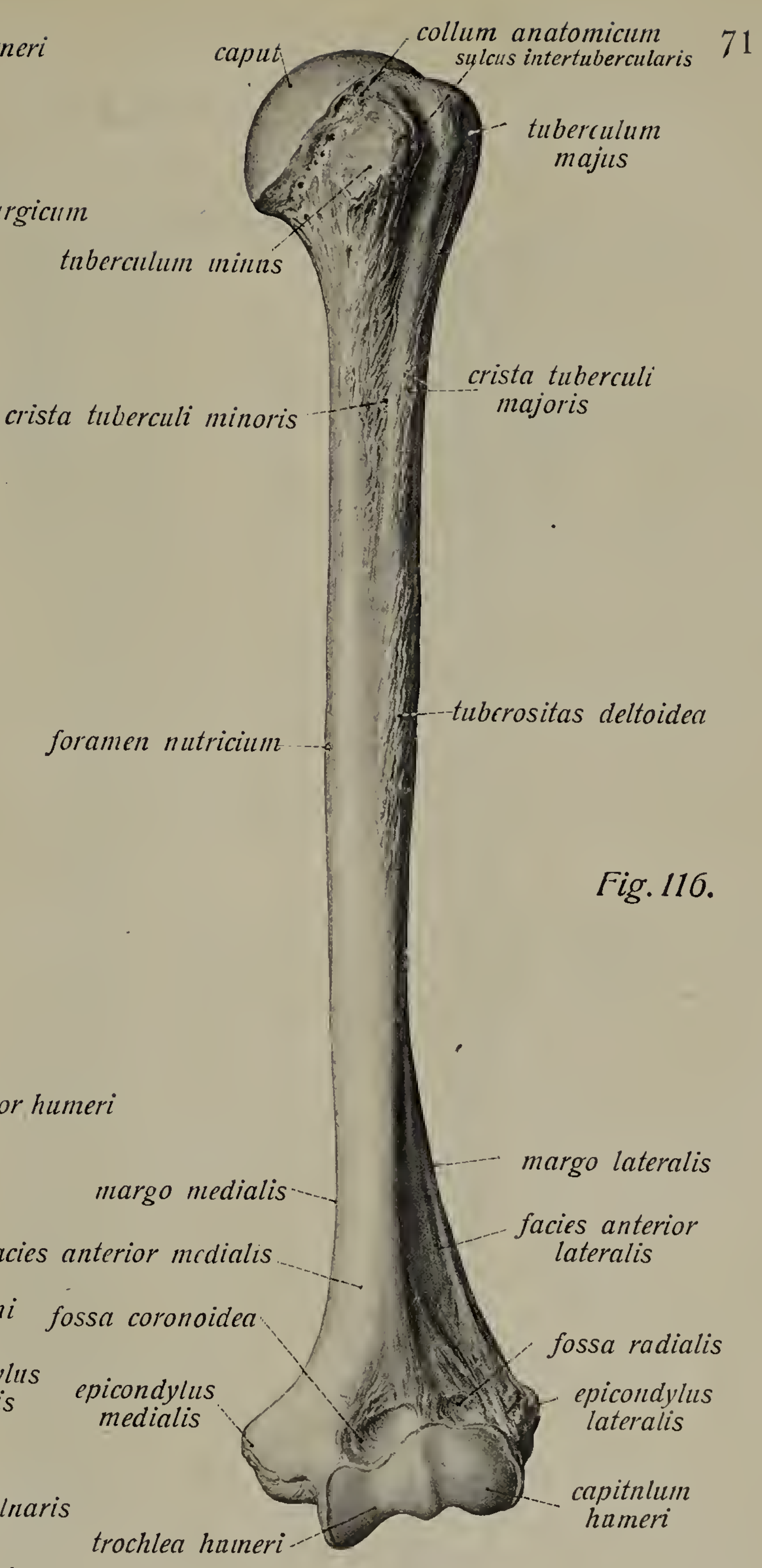


Fig. 115.



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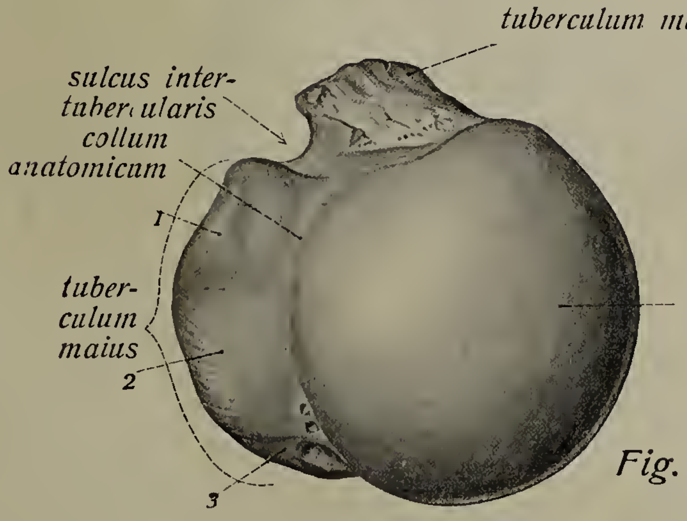

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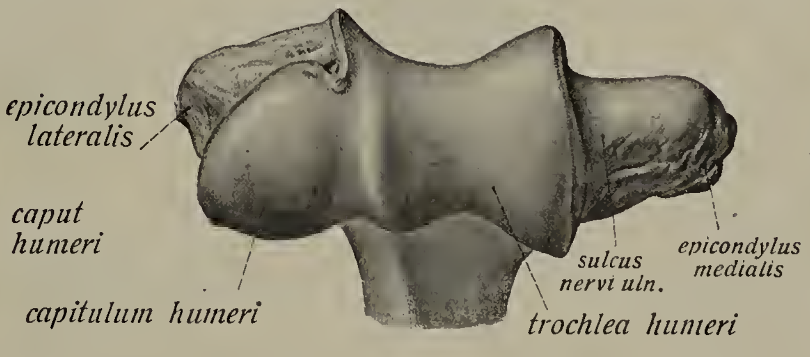


Fig. 118.

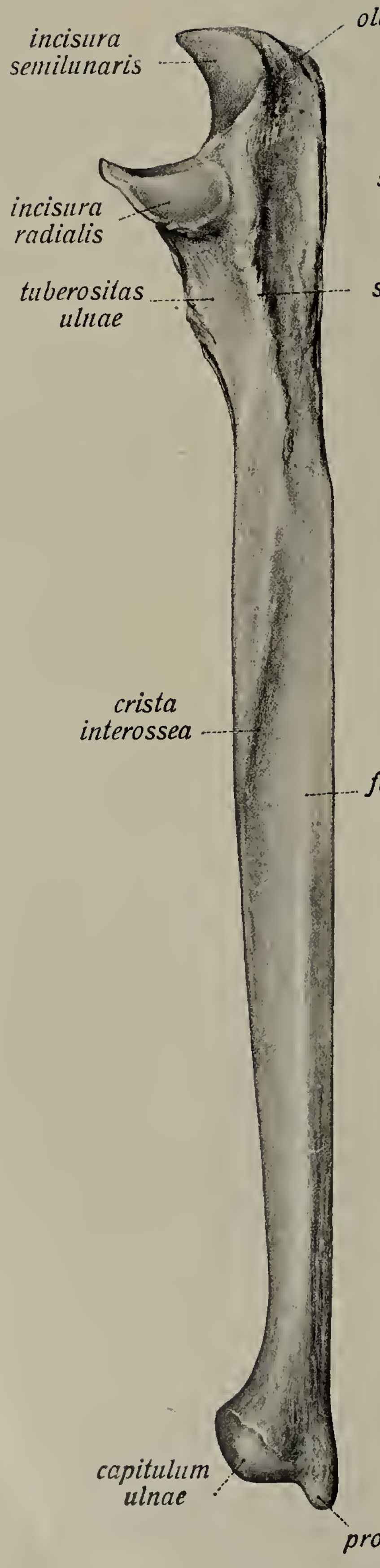


Fig. 119.

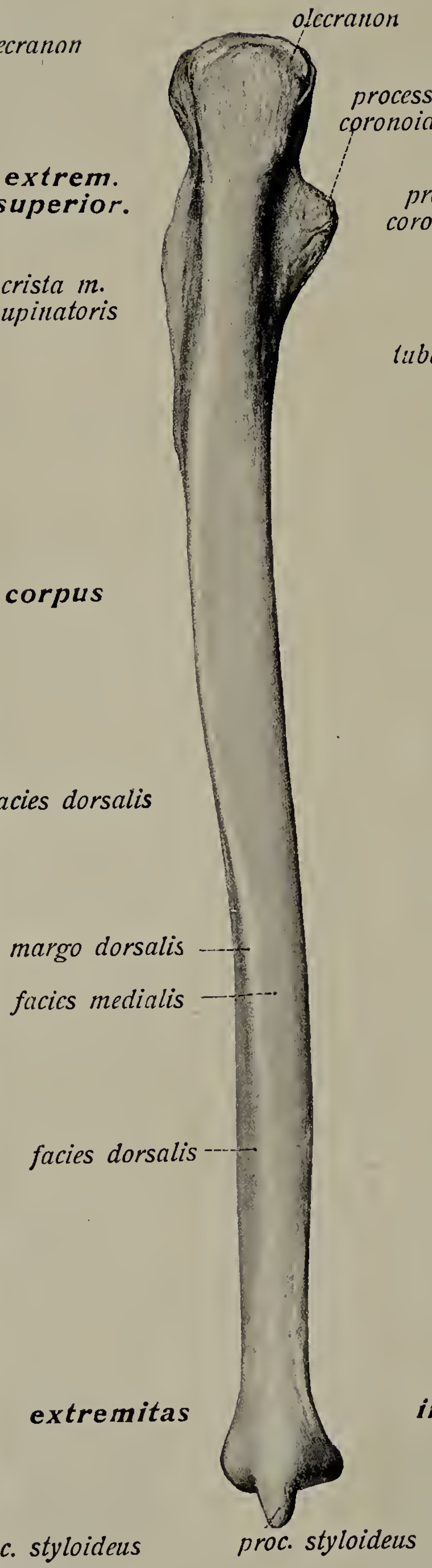


Fig. 120.

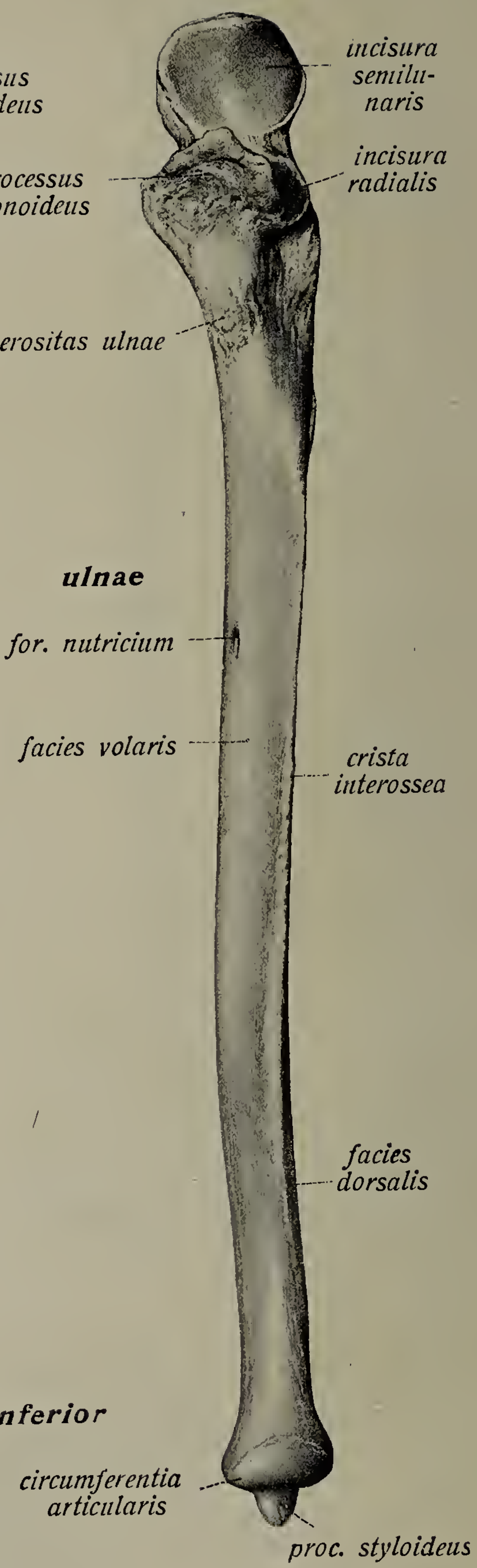


Fig. 121.

The Ulna.

Fig. 119. The left ulna from the lateral surface. $(^2/_3)$
Fig. 120. The left ulna from the medial surface. $(^2/_3)$
Fig. 121. The left ulna from in front. $(^2/_3)$

The *ulna* is a distinctly triangular-prismatic long bone, thick above and much thinner below. It presents a superior extremity, a *body* or shaft *(corpus)* and an inferior extremity. The stout *superior extremity* carries the *semilunar notch* with the constricted, or even divided, articular surface for the trochlea of the humerus. Its anterior portion lies on the upper surface of the *coronoid process,* a broad, beak-like projection, while its posterior portion is on the anterior surface of a very strong, upwardly projecting process, the *olecranon.* On its lateral side the upper extremity has a notch lined with cartilage, the *radial notch,* for the reception of the head of the radius. From it a rough ridge extends downwards on the upper part of the dorsal surface, the *supinator crest,* for the muscle of that name. Immediately below the coronoid process is a broad rough area, the *ulnar tuberosity.*

The *shaft (corpus)* of the bone is much thicker above than below, and at the same time becomes rounded below, the upper distinctly triangular portion becoming cylindrical in the lower fourth. An anterior or *volar,* a posterior or *dorsal* and a *medial* or ulnar surface may be recognized. The *dorsal border* separates the dorsal and medial surfaces and the *volar border* the volar and medial surfaces. The third border, turned toward the radius, is sharp; it separates the volar and dorsal surfaces and is termed the *interosseous crest.* The volar surface bears the *nutrient foramen,* otherwise the surfaces present no special markings.

The distal end of the bone, the *inferior extremity,* is the *capitulum;* it is rounded and covered by cartilage. On the radial side there is also an articular surface for the radius, the *articular circumference,* as well as a sharp process, projecting distally beyond the capitulum on the medial side, the *styloid process.*

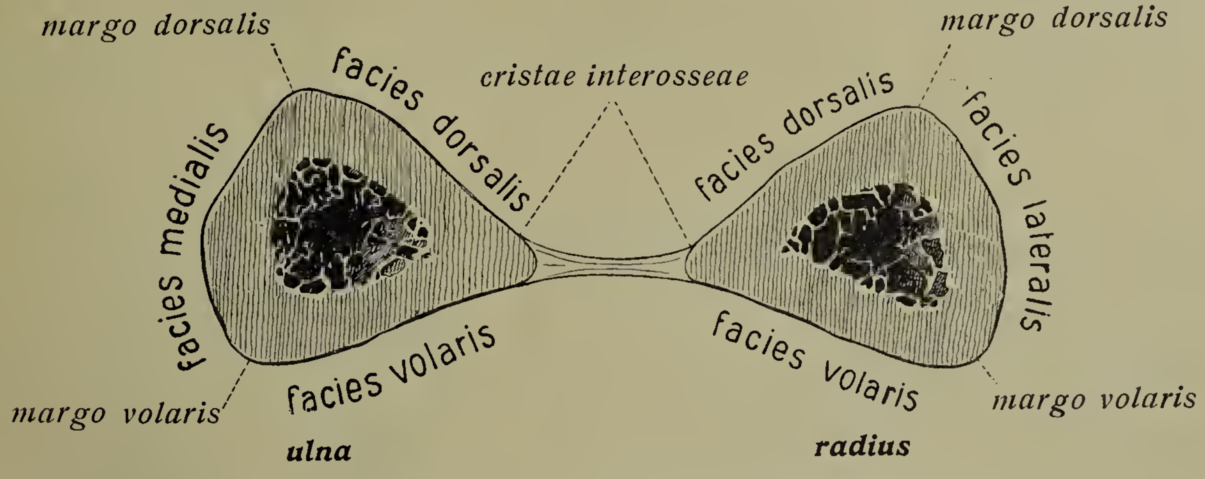


Fig. 122. Transverse section, at about the middle of their length, of the bones of the left forearm (schematic).

The Radius.

Fig. 123. The left radius from in front. ($^2/_3$)
Fig. 124. The left radius, medial surface. ($^2/_3$)
Fig. 125. The left radius from behind. ($^2/_3$)
* = attachment of pronator teres. ** = groove and ridge for the extensor tendons.
Fig. 126. The upper ends of the radius and ulna from above and somewhat from in front. ($^2/_3$)
Fig. 127. The lower ends of the radius and ulna from below. ($^2/_3$)

The *radius* is the more lateral of the two bones of the forearm. In contrast to the ulna it is small above and broad and thick below.

The *superior extremity* is formed by the disk-shaped *capitulum* and a distinct circular constriction below this is termed the *neck (collum).* In its upper part the bone is almost cylindrical. The capitulum bears on its upper surface an articular depression or *fovea* for the capitulum of the humerus and a second articular surface, the *articular circumference,* that completely surrounds its margin. Below the neck on the upper part of the volar surface there is a distinctly elevated rough area, the *tuberosity,* which gives attachment to the biceps muscle.

The *shaft (corpus)* of the radius, like that of the ulna, is triangular-prismatic. The three surfaces are also placed as in that bone, so that a *volar,* a *dorsal* and a *lateral* (radial) surface may be distinguished and *volar* and *dorsal* borders as well as an *interosseous crest.* The last lies opposite the similarly named crest of the ulna and is the only sharp border of the radius, the others being rounded. The three surfaces present no markings of importance except some roughenings for muscles, such as that for the pronator teres. Usually a *nutrient foramen* occurs on the volar surface.

The *inferior extremity* is greatly broadened and flattened, so that in its region only a volar and a dorsal surface may be distinguished. The interosseous crest passes below into a slightly concave surface, the *ulnar notch,* which furnishes an articular surface for the capitulum of the ulna. Opposite it a *styloid process* projects beyond the general inferior surface of the bone; it is broader and less pointed than the similarly named process of the ulna.

The volar surface of the inferior extremity is smooth and slightly concave, the dorsal surface on the contrary presents distinct grooves with intervening ridges for the extensor muscles of the hand and fingers, one, especially deep and with an oblique course, being for the tendon of the extensor pollicis longus. On the distal terminal surface, which is turned toward the hand, there is a concave *carpal articular* surface, usually distinctly divided into two areas. By means of this surface the radius articulates with the navicular (scaphoid) and lunate bones of the hand.

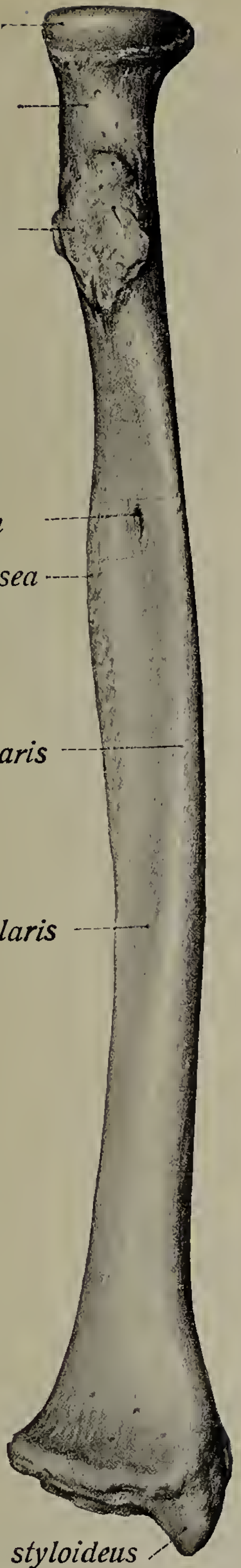


Fig. 123.

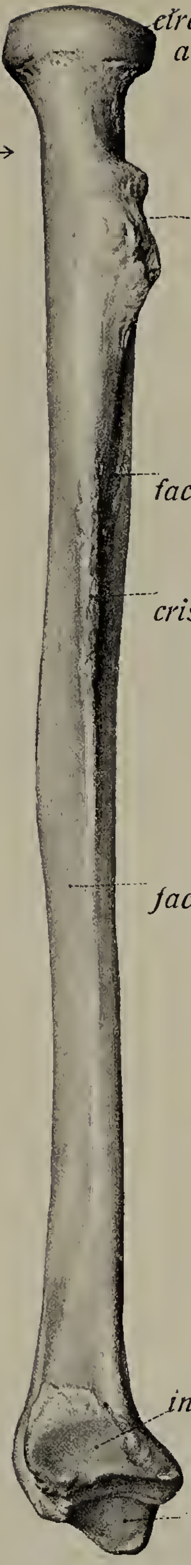
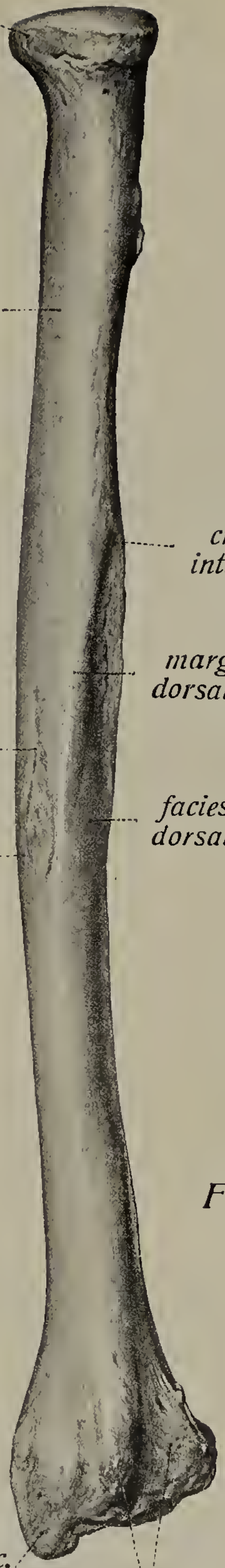


Fig. 124.



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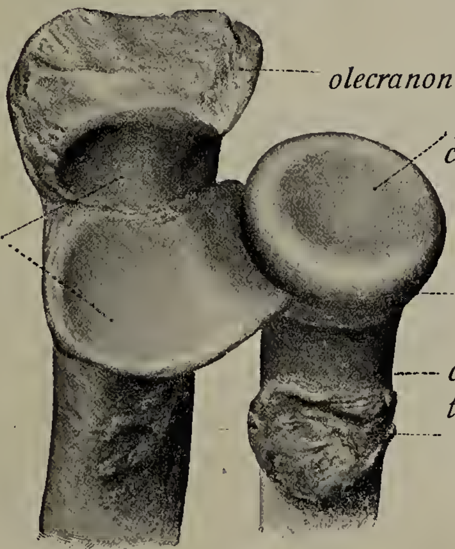
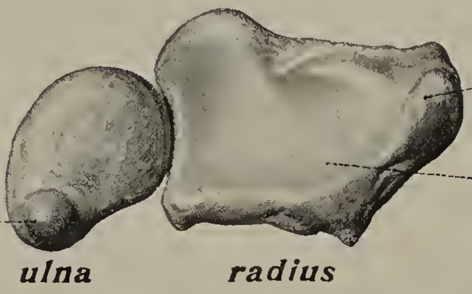


Fig. 126.



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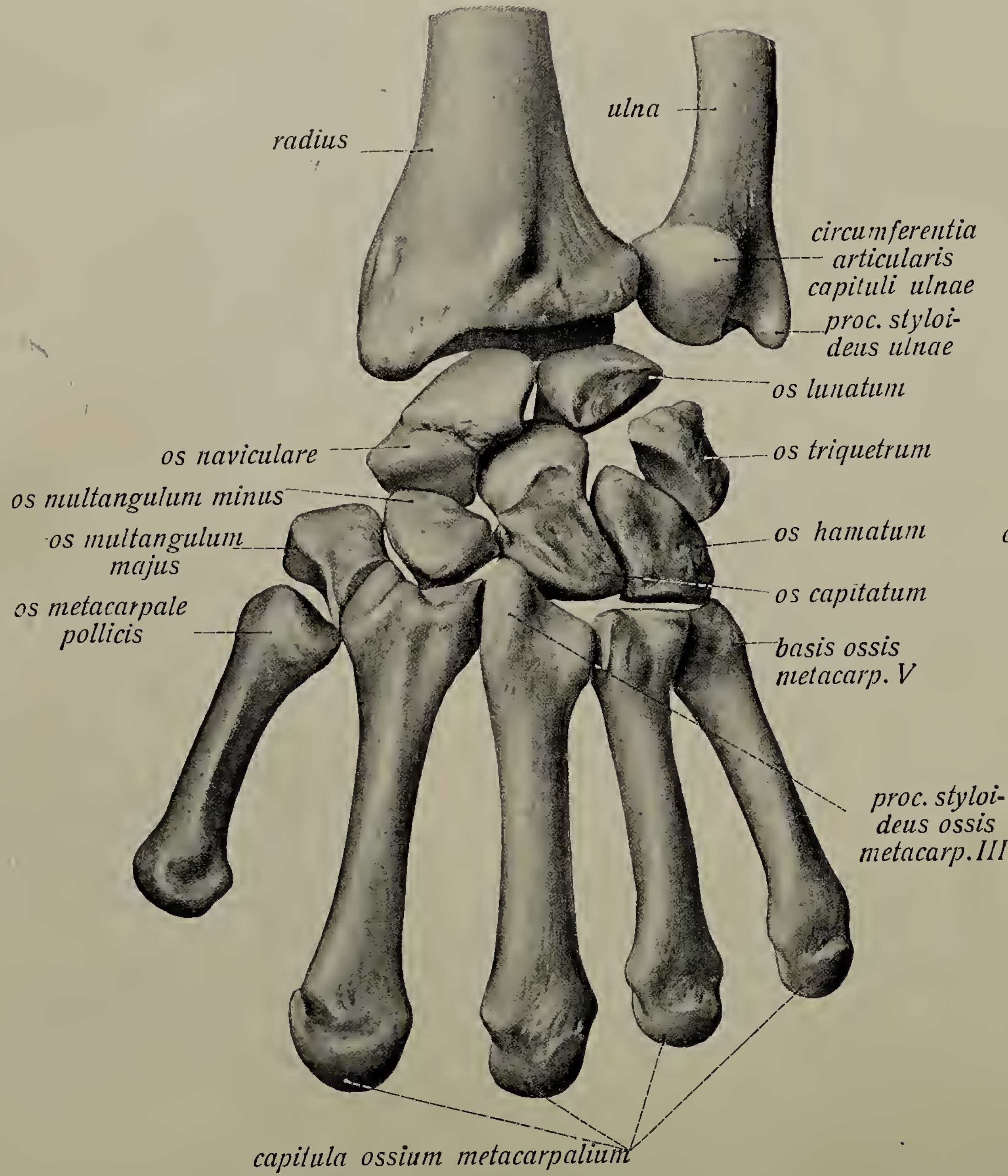

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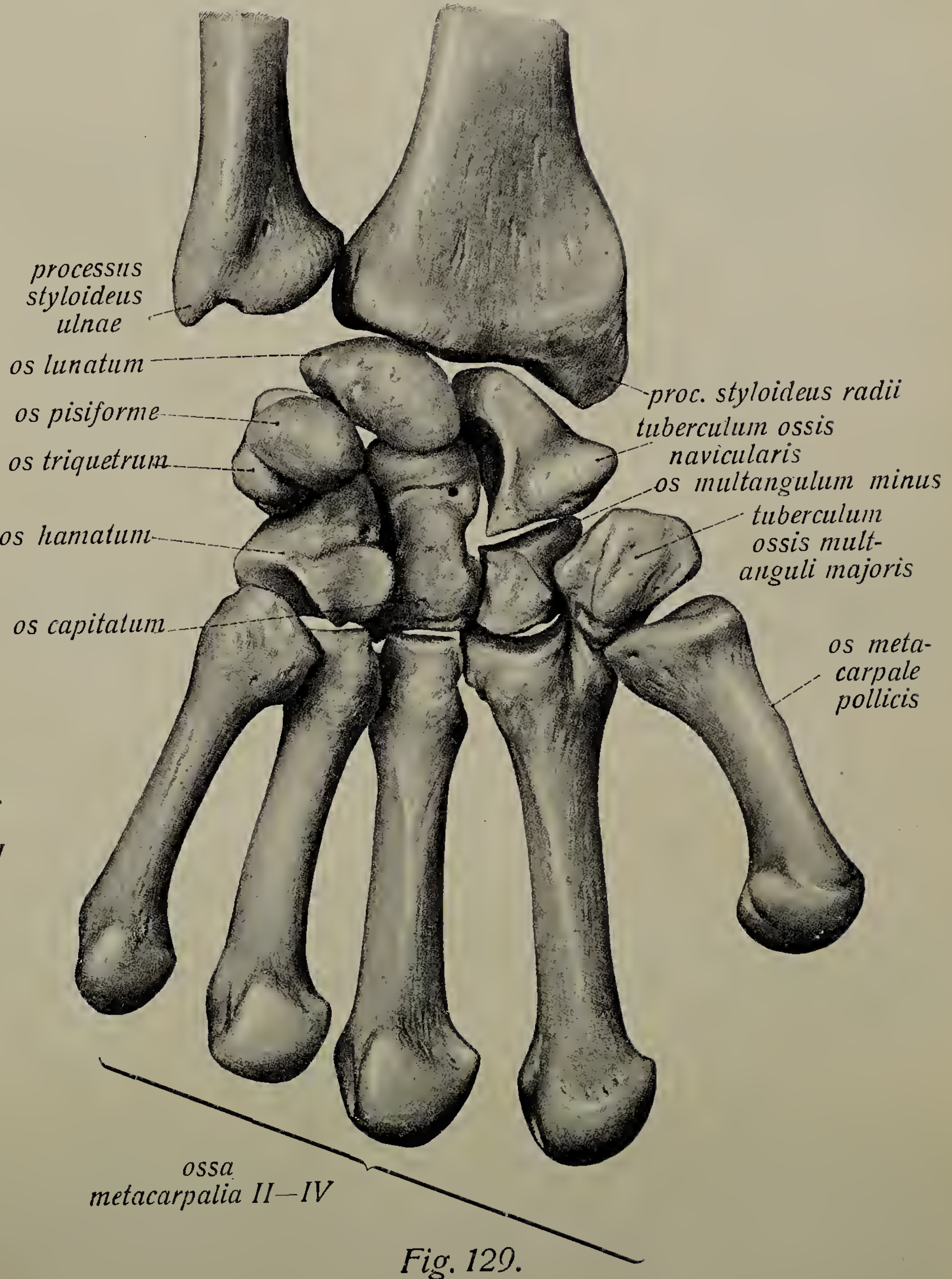


Fig. 129.

The Bones of the Left Hand.

The Carpus.

The eight bones of the *carpus* are arranged in two rows, a proximal and a distal. Those of the proximal row, named from the radial side are the *navicular (scaphoid),* the *lunate,* the *triquetrum* or *cuneiform* and the *pisiform;* those of the distal row named in the same order are the *trapezium (greater multangular),* the *trapezoid (lesser multangular),* the *capitate* or *os magnum* and the *hamate* or *unciform.* The bones of the proximal row do not lie in a straight line, but form an arch, slightly convex proximally and deeply concave distally. Similarly from the row of distal bones, one, the capitate, projects strongly towards the bones of the proximal row and fills their concavity.

The carpal bones are very irregular in shape; they do not lie in a plane but form a dome, convex dorsally and concave volarly. The dome is increased by two bony projections on the radial and ulnar sides of the volar surface of the carpus, a deep groove, the *carpal groove* lying between them. These projections are the *ulnar* and *radial eminences.* The latter is formed by the *tubercle of the navicular (scaphoid)* and the *tubercle of the trapezium (greater multangular),* the former by the *pisiform* and the *hamulus* of the *hamate (unciform).* The small, almost spherical pisiform bone lies on the volar surface of the carpus; all the other bones of the carpus have each a dorsal and a volar, more or less roughened surface. In the cases of the four bones at the sides of the carpus, the navicular (scaphoid), trapezium (greater multangular), triquetrum (cuneiform) and hamate (unciform), the dorsal and ventral surfaces are united by lateral ones, radial or ulnar. The numerous remaining surfaces are smooth, articular surfaces for articulation with the radius, the metacarpal bones or adjacent carpal bones. The pisiform has only one small, flat, articulating surface for articulation with the triquetrum (cuneiform); all the other bones have several. The more important of these surfaces are the following: — The navicular (scaphoid) and lunate have each a convex surface for articulation with the distal end of the radius; the triquetrum (cuneiform) does not, however, articulate with the ulna, but with a triangular cartilage that separates it from the ulna. Between the proximal and distal rows, the joint between the convex head of the capitatum (os magnum) and the concavity formed by the lunate and navicular (scaphoid) is the most important. The first metacarpal articulates by a distinctly saddle-shaped surface with the trapezium (greater multangular), the second with the trapezoid (lesser multangulum), the third with the capitate (os magnum), while the hamatum (unciform) bears the two ulnar metacarpals.

Fig. 128. The lower ends of the radius and ulna, the carpal and metacarpal bones in their natural relations. View of the dorsal surface. ($^4/_5$)

Fig. 129. The same from the volar surface. ($^4/_5$)

The Bones of the Left Hand. (Cont.)

The Metacarpus.

The *metacarpal bones* are typical long bones, in which a proximal portion or *base,* a *body (corpus)* and a distal portion or *capitulum* may be distinguished. The bases articulate with the distal row of carpal bones, the capitula with the proximal row of phalanges. The metacarpal of the thumb is the shortest, that of the index the longest, and from this toward the little finger they gradually diminish in length.

The bases of the metacarpals are irregularly cubical; that of the thumb bears a saddle-shaped surface for articulation with the trapezium (greater multangular), the rest, in addition to the surfaces for the carpal bones, have also lateral surfaces for articulation with one another. The base of the third metacarpal bears a *styloid process,* which is directed laterally (radially).

The almost triangular prismatic *bodies* of the metacarpals, except that of the thumb, have each a volar and a dorsal angle; the latter broadens to a surface towards the capitulum, the former flattens towards the base. The capitula are spherical in shape; at their sides are depressions that give attachment to ligaments.

The bases are closely applied to one another, except in the case of the freely moveable metacarpal of the thumb; on the other hand, the bodies and the capitula are separated by considerable intervals, the *interosseous spaces.*

The Phalanges.

Each finger has three *phalanges,* the thumb only two. The basal phalanx is termed the *first phalanx,* the middle one the *second phalanx* and the distal or terminal one the *third phalanx.* The thumb lacks the second phalanx. The lengths of the phalanges diminish toward the finger tips, so that the terminal phalanges are the shortest.

Fig. 130. The bones of the left hand separated from one another, the dorsal surface. ($^{3}/_{5}$)

Fig. 131. The same, volar surface. ($^{3}/_{5}$)

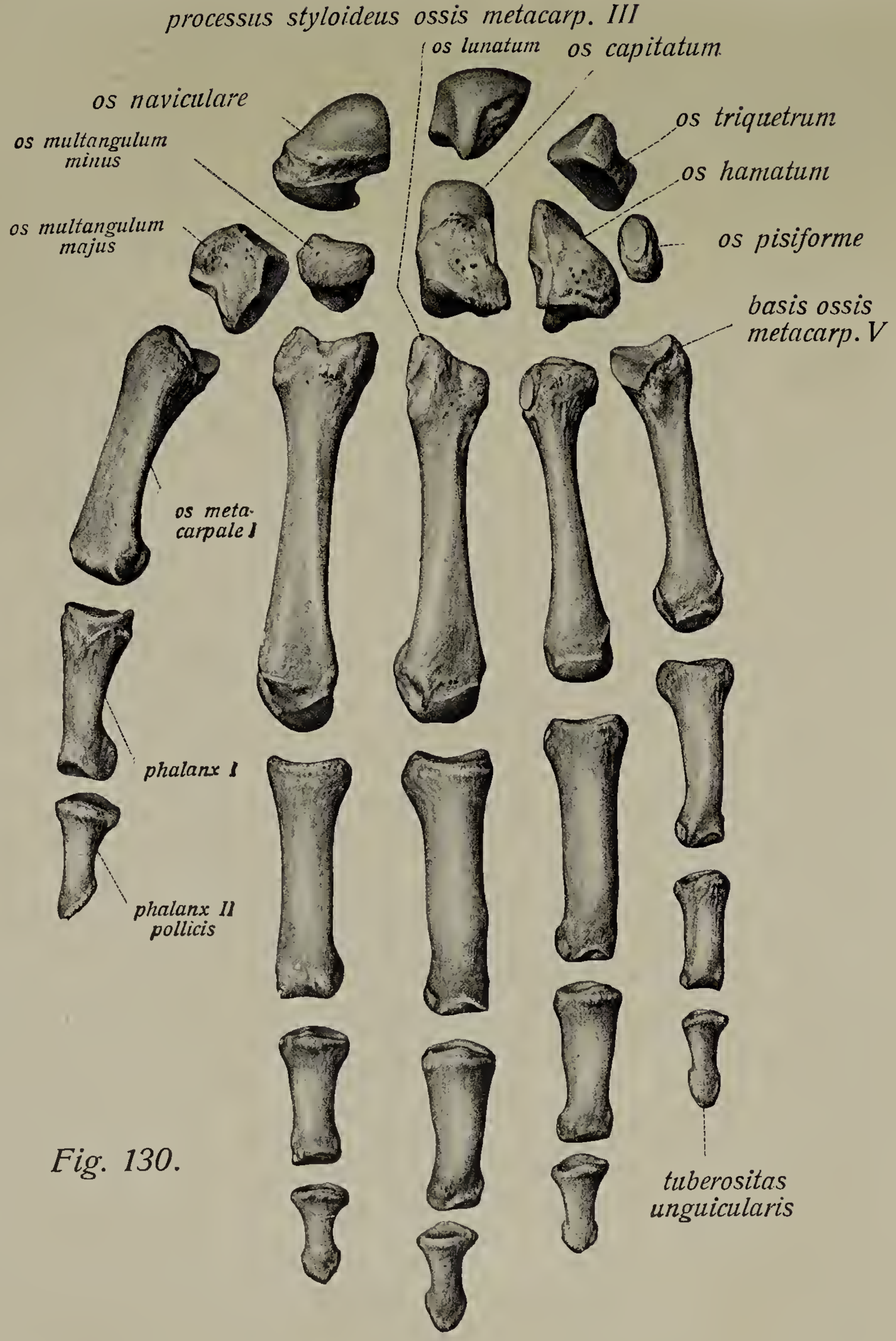


Fig. 130.

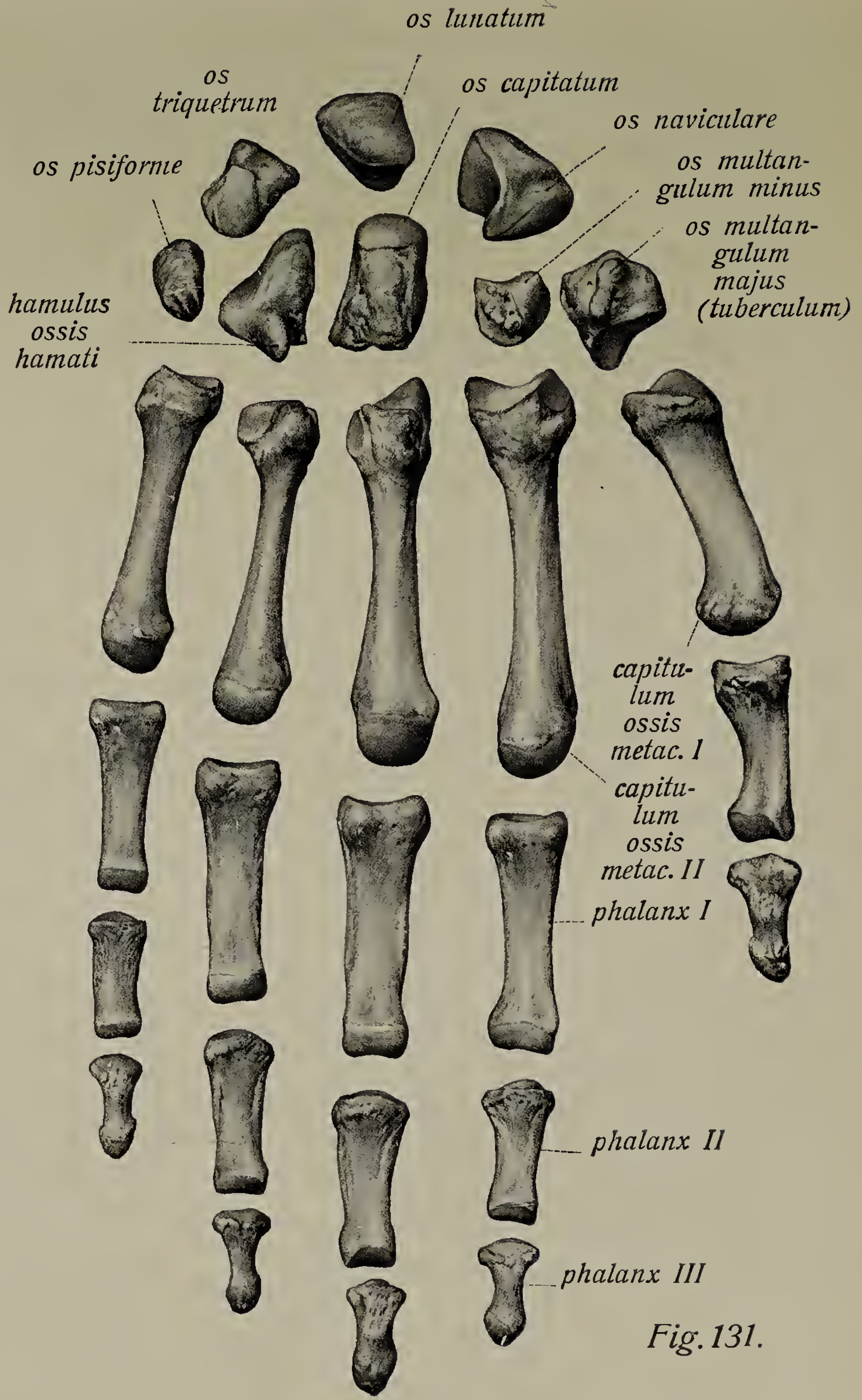


Fig. 131.

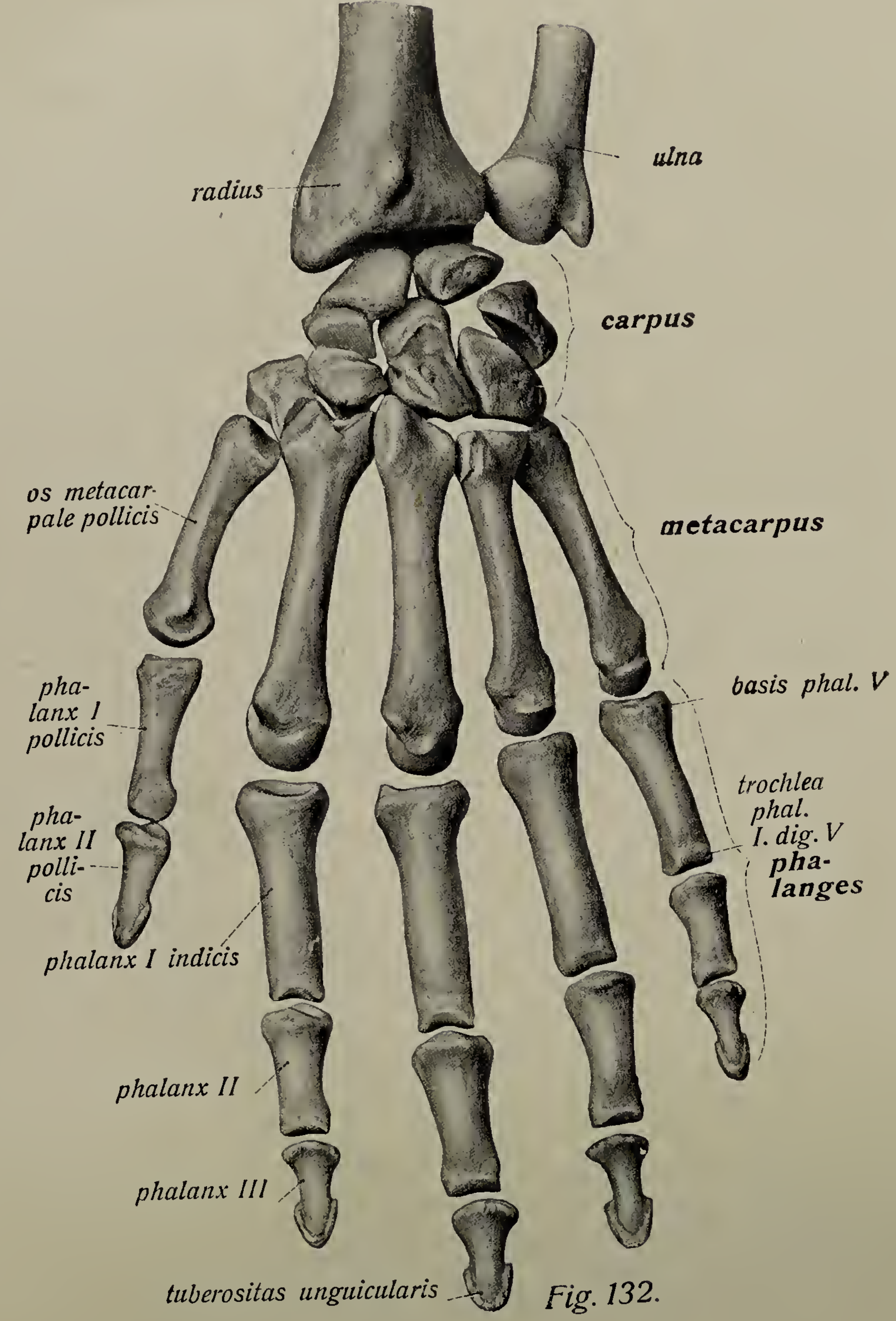


Fig. 132.

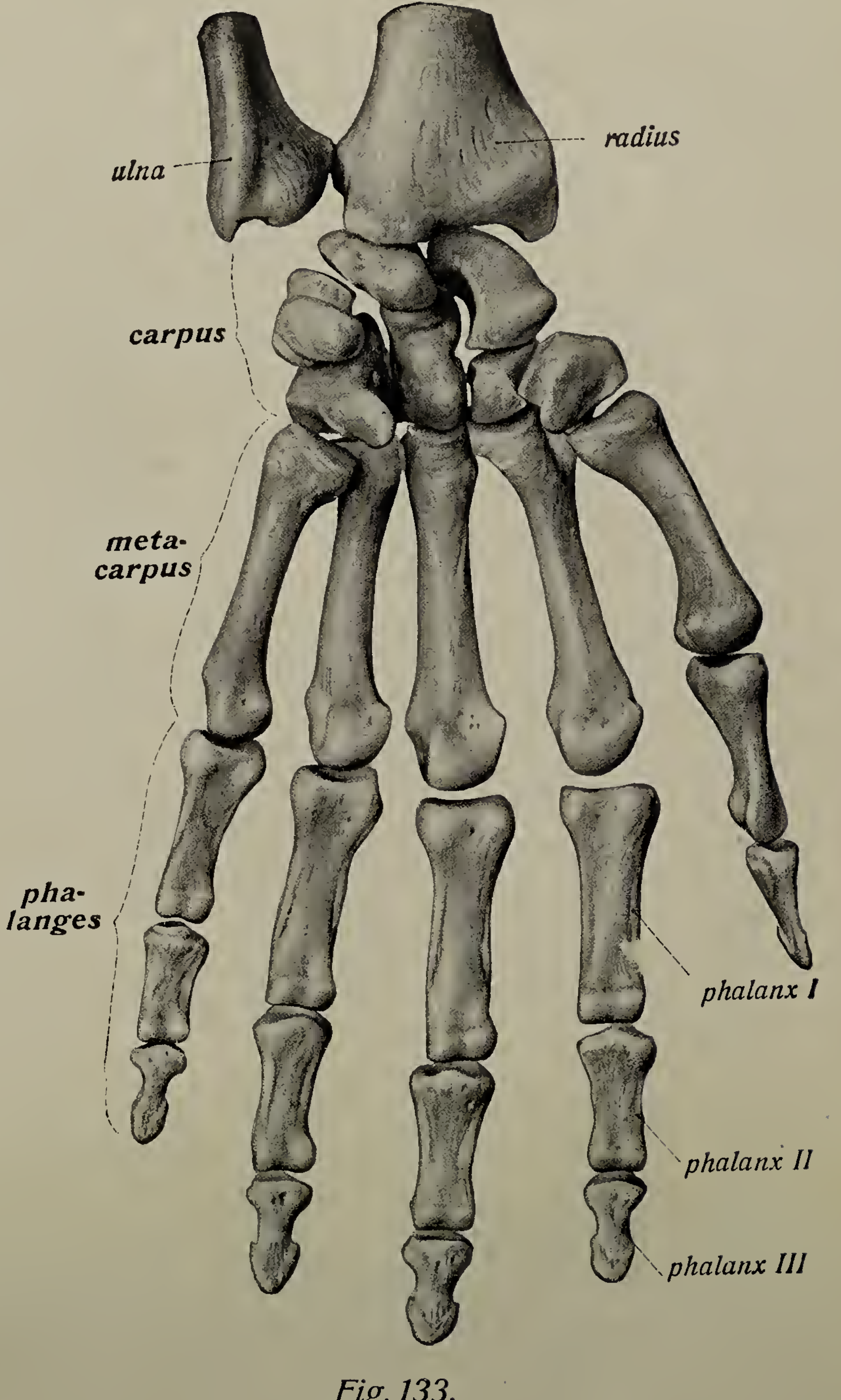


Fig. 133.

The Bones of the Left Hand. (Cont.)

The longest phalanx is the basal one of the middle finger. The phalanges are long bones with a proximal extremity or *base*, a *body (corpus)* and a distal extremity or *trochlea.* The bases of the proximal phalanges have hollow spherical sockets for the capitula of the metacarpals, those of the middle and distal phalanges are hollow cylindrical, with a median elevation, corresponding in form to the trochleae.

The bodies of the phalanges are convex dorsally and flat or very slightly concave on the volar surfaces, with sharp lateral borders. The terminal phalanges have no trochleae, but the short bodies pass into a rough horse-shoe shaped enlargement, the *unguicular tuberosity.* At the distal ends of the proximal and middle phalanges there are foveae for the attachment of ligaments, similar to those on the metacarpal capitula.

In addition to the bones that have been mentioned there are in the hand a variable number of *sesamoid bones.* Two occur constantly at the metacarpo-phalangeal joint of the thumb and occasionally others are found at the corresponding joints of the index and little fingers and at the interphalangeal joint of the thumb. In the little finger they may be replaced by fibro-cartilage. In the thumb they are usually covered with cartilage on one side and are connected with the joint (see Fig. 207).

In the region of the metacarpus and fingers the bones of the hand do not form a flat surface, but a dome convex dorsally and concave volarly, which may be markedly deepened by the action of the muscles of the hand and also not a little flattened. The highest point of the convexity of the back of the hand is the metacarpal of the index finger. From this the curvature falls gradually toward the little finger and quite suddenly toward the thumb. The bones of the thumb, the metacarpal as well as the two phalanges, are placed with their surfaces directed laterally and medially, instead of dorsally and volarly as in the other fingers; the bones of the thumb, therefore, turn towards the dorsum of the hand a border and not a surface. In the metacarpal of the little finger, also, the dorsal surface looks distinctly medially.

While the metacarpal bone of the index is the longest the phalanges of the middle finger are longer than those of the index, so that the middle finger is the longest of all the fingers. The phalanges of the ring finger are also usually longer than those of the index. Corresponding to the function of the hand as a grasping organ the fingers are strongly developed, forming almost half the length of the entire hand. The length of the carpus is about only $^1/_6$ the length of the entire hand.

Fig. 132. The skeleton of the entire hand with the lower ends of the forearm bones, dorsal surface. ($^3/_5$)

Fig. 133. The same, volar surface. ($^3/_5$)

The Skeleton of the Right Lower Extremity.

The Right Pelvic Girdle.

The Innominate Bone *(os coxae).*

The *innominate bone (os coxae)* consists at puberty of three bones united by synchondroses, the *ilium*, the *pubis* and the *ischium.* All three bones meet in the articular cavity for the femur *(acetabulum).* The ilium forms the upper portion of the compound bone; it is the largest of the three bones and forms the upper third of the acetabulum. It consists of *a body (corpus)* and an *ala.* The pubis forms the lower and anterior portion of the innominate and the lower anterior third of the acetabulum. It is separated from the ischium by a large roundish foramen, the *obturator foramen*, but is also united with it in the inferior boundary of the foramen. It has a *body (corpus)* and two rami, a *ramus superior*, forming the upper boundary of the obturator foramen, and a *ramus inferior.* The ischium forms the lower posterior portion of the innominate, the lower posterior third of the acetabulum and the lower and posterior boundary of the obturator foramen. It consists of a body *(corpus)* and two rami, *superior* and *inferior.*

The Ilium.

The **ala** of the **ilium** has somewhat the form of a broad flat shovel. At its central part it is often as thin as paper, but its upper border is thickened and rough and is termed the *iliac crest.* Upon this may be seen three parallel rough lines, most distinct at the middle of the crest, where it reaches its highest point. These lines are termed the *outer lip*, the *inner lip* and the *intermediate lip.* Anteriorly the crest ends in a projection, the *anterior superior spine;* at its posterior end is a less distinct *posterior superior spine*, and below this, separated from it by a slight notch, is the *posterior inferior spine.* Upon these there follows at the posterior end of the innominate a deep, parabolic notch, the *great sciatic notch (incisura ischiadica major);* its upper boundary is the posterior border of the ala of the ilium and its lower and anterior boundaries are the bodies of the ilium and ischium. Below the anterior superior spine, on the body of the ilium, is the *anterior inferior spine.*

The lateral surface of the ala is rough and convex and its principal markings are three rough lines, the *posterior*, *anterior* and *inferior gluteal lines.* The posterior line runs almost vertically over the posterior part of the ala to the upper boundary of the great sciatic notch. The longer anterior line runs from the anterior superior spine as an arch, at first almost horizontal and then almost vertical, to the upper border of the great sciatic notch where it ends not far from the posterior line. The inferior gluteal line is markedly shorter than the anterior, and forming a weak arch beginning between the anterior superior and anterior inferior spines, it runs above the acetabulum and almost horizontally to the middle of the great sciatic notch.

Fig. 134. The right innominate bone, lateral surface. $({}^{1}/_{2})$

Fig. 135. The right innominate bone, medial surface. $({}^{1}/_{2})$

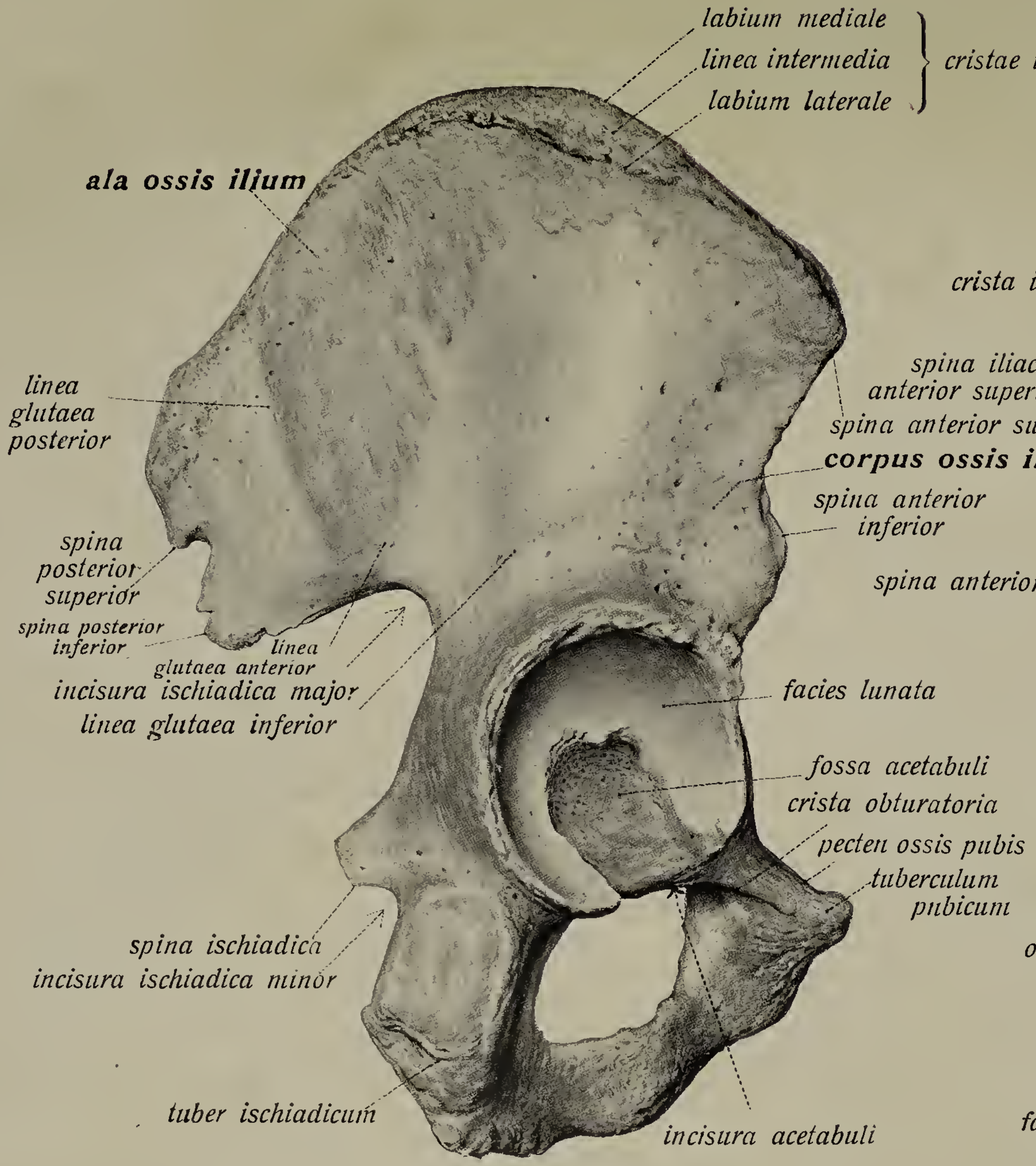


Fig. 134.

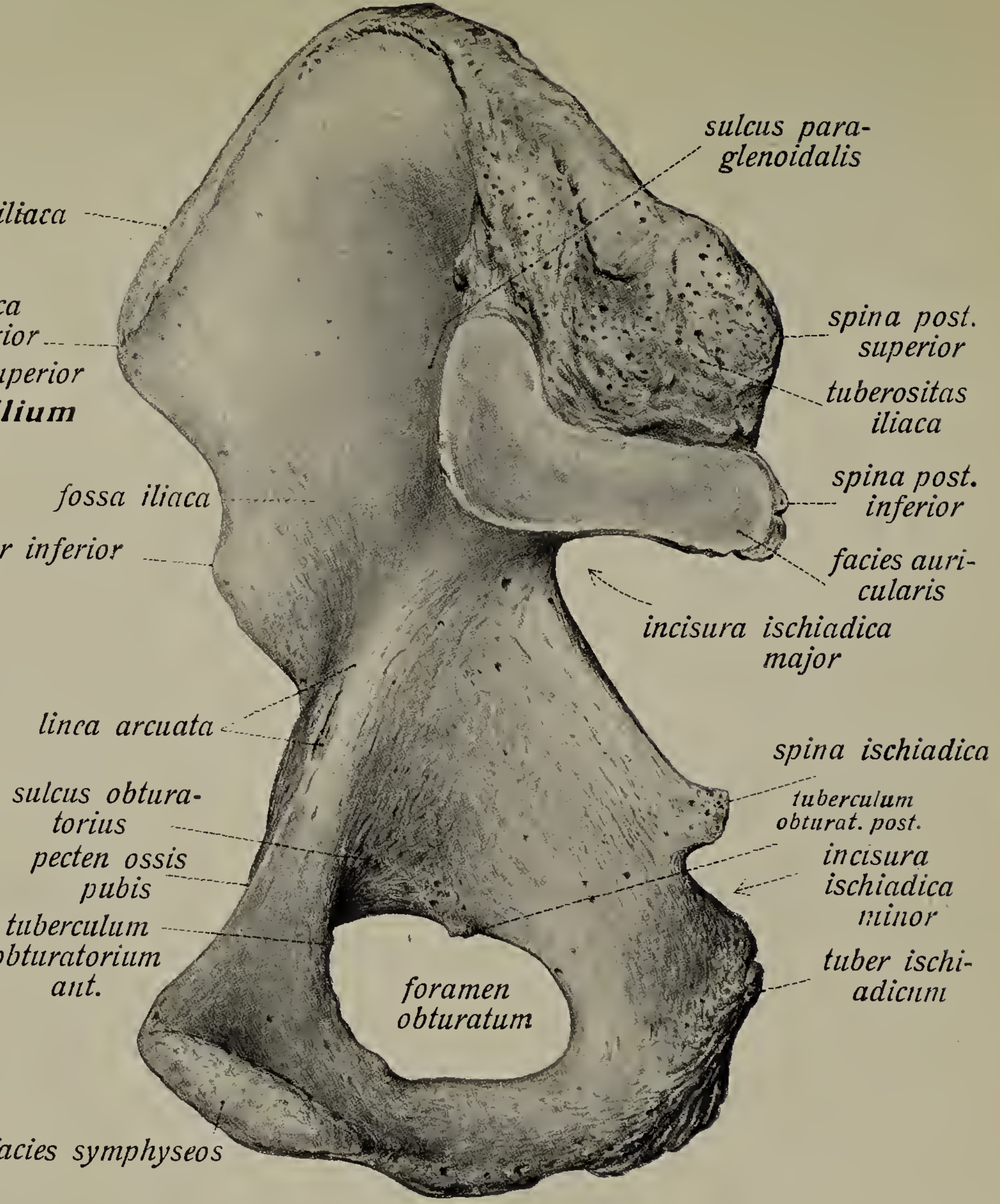


Fig. 135.

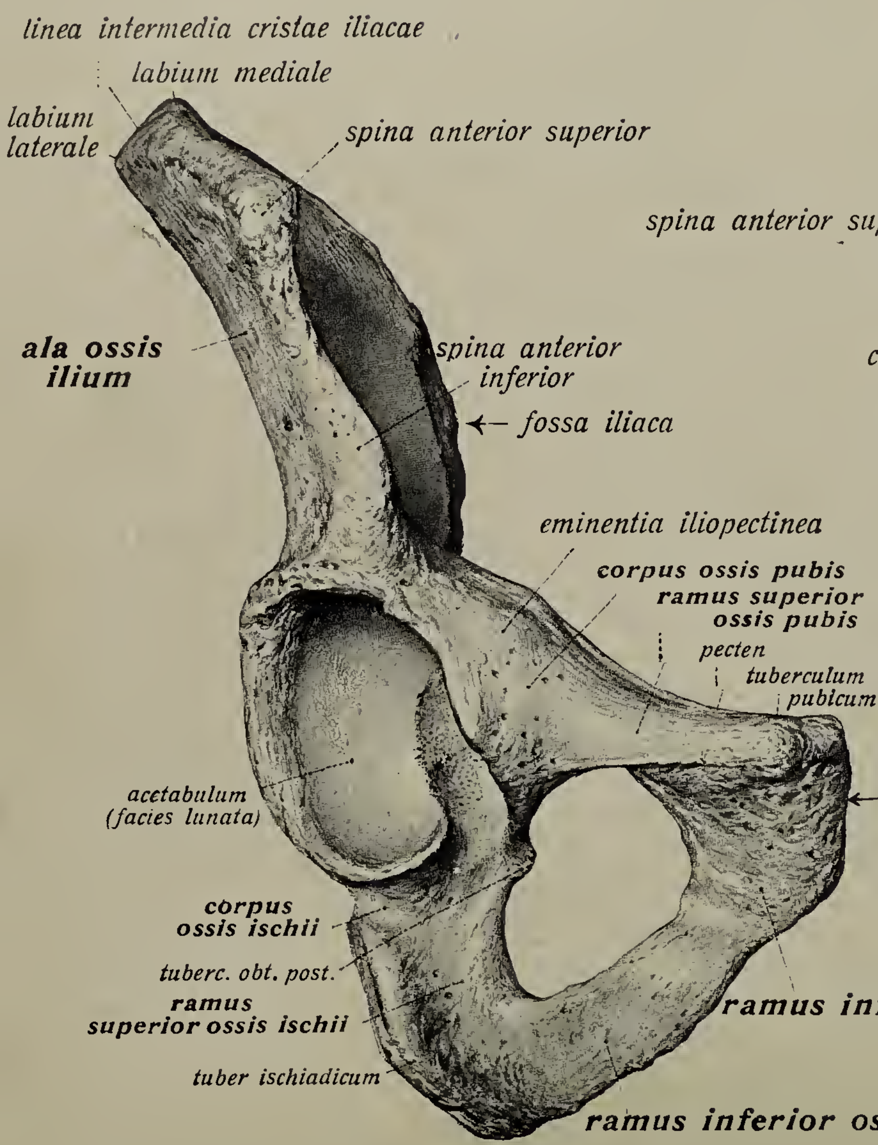


Fig. 136.

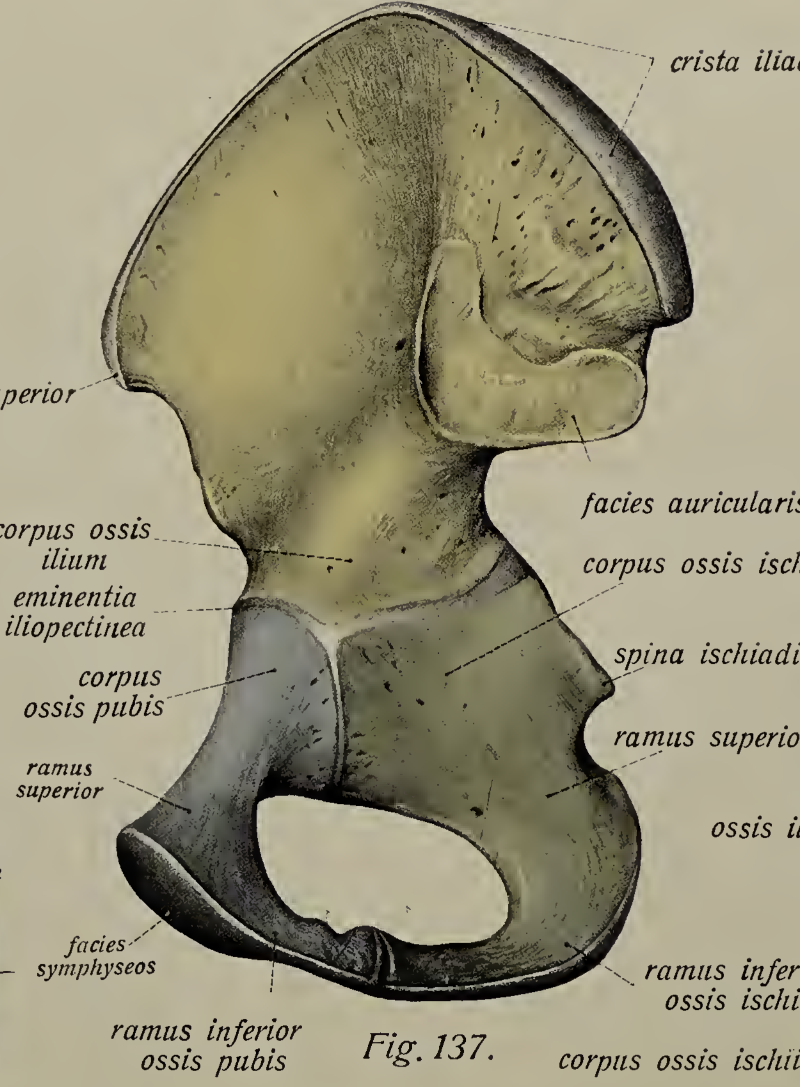


Fig. 137.

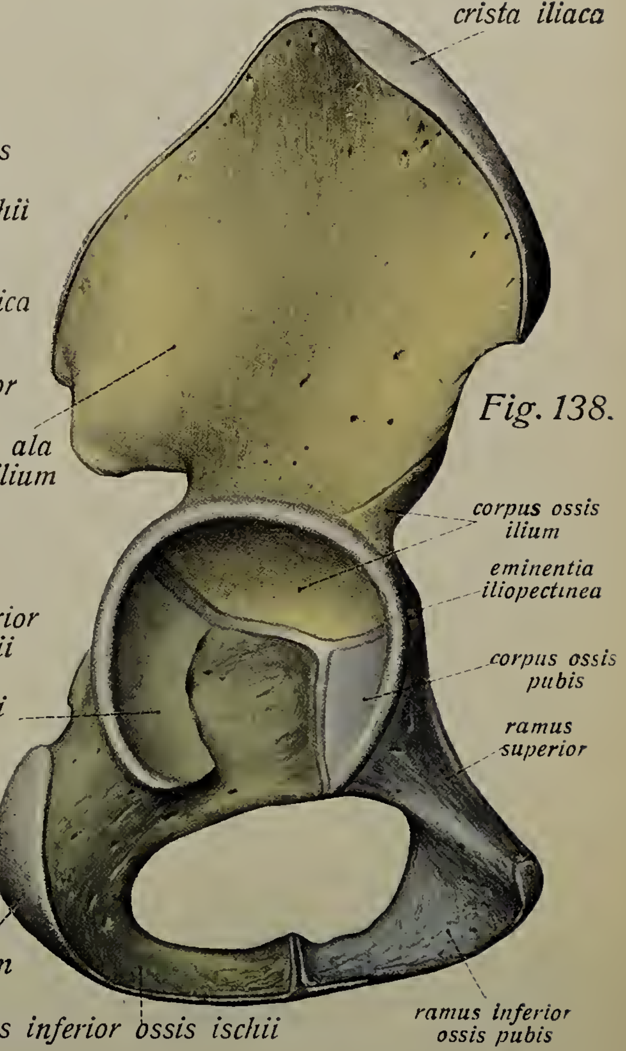


Fig. 138.

The Innominate Bone *(Os coxae).* (Cont.)

Fig. 136. The right innominate bone from in front. (${}^1/_2$)

Fig. 137. The innominate bone of a 5—6 year old child, medial surface. (${}^1/_1$)

Fig. 138. The same, lateral surface. (${}^1/_1$)

Ilium yellow, pubis blue, ischium green. The iliac crest, the ischial tuberosity and part of the acetabulum are still cartilaginous (white in the figures).

The medial surface of the ala of the ilium has two portions, a larger anterior one which is slightly convex and is termed the *iliac fossa* and an uneven posterior one. On the latter again there may be made out two portions, corresponding to portions of the sacrum with similar names, the lower and anterior *auricular surface* and the posterior and upper, very much roughened *iliac tuberosity.* The auricular surface is bounded by a slight *paraglenoid groove.* The iliac fossa is separated from the rest of the innominate by a line which is continued upon the pubis and is called the *arcuate line;* it forms a part of the boundary line (linea terminalis) separating the false and the true pelves. The body of the ilium forms the upper part of the acetabulum; it passes on the inner surface into the ala without demarcation and in the adult, in a similar manner, into the bodies of the pubis and ischium.

The **pubis** of the adult is intimately connected with the ilium and ischium and forms part of the acetabulum. Where the pubis and ilium meet there is a low, rounded elevation, the *iliopectineal eminence.* From the body of the bone there arises the triangular *superior ramus,* which lies almost horizontally and bears at its anterior end the elongated *symphyseal surface* for union with the bone of the opposite side; it also forms the upper boundary of the *obturator foramen.* On its upper surface is a sharp ridge, the *pecten,* which is a continuation of the arcuate line of the ilium. This ends anteriorly in a small elevation, the *tubercle,* not far from the symphyseal surface. Where the superior ramus arises from the body there is a broad obturator groove on the medial surface of the bone; it is bounded medially by the *obturator crest.* At the obturator groove anteriorly there is an elevation, the anterior obturator tubercle, directed toward the obturator foramen, and on the ischium *a posterior tubercle.* The *inferior ramus* passes obliquely downwards and laterally from the symphyseal surface.

The **ischium** forms the lower anterior part of the acetabulum, and in the adult passes over without demarcation into the ilium and pubis. It forms the lower anterior boundary of the great sciatic notch, below which it projects as a broad, flattened, but sharp *spine.* Below this is the *lesser sciatic notch (incisura ischiadica minor),* which lies entirely in the ischium and whose lower boundary is a strong roughened protuberance, the *tuberosity.* From the neighborhood of this the *inferior ramus* ascends at a sharp angle to the *superior ramus.* With the lower ramus of the pubis it forms the lower boundary of the obturator foramen.

The *acetabulum* is formed by the bodies of the three bones, but the lines of separation between these can be seen only in youthful bones. It is almost hemispherical, with elevated borders, and looks almost laterally. Below towards the obturator foramen there is a notch in its border, the *acetabular notch.* The bottom of the cavity shows two portions, the *lunate surface,* covered with cartilage, which forms the upper and lateral portions of the cavity, and the almost square, rough and uneven *acetabular surface.*

The Skeleton of the Right Free Lower Extremity.

The Right Femur.

Fig. 139. The right femur from behind (see also Fig. 142). ($^2/_5$)
Fig. 140. The right femur, medial surface. ($^2/_5$)
Fig. 141. The right femur from in front. ($^2/_5$)

In the *femur* there may be distinguished a *superior extremity,* a body or shaft *(corpus)* and an *inferior extremity.* The superior extremity bears the *head (caput)* at the extremity of a *neck (collum),* which passes into the shaft at an obtuse angle. The head is somewhat more than a hemisphere and is covered with cartilage, except at a slight depression near its centre, the *fovea.* The neck (collum) is strongly constricted near the head but enlarges laterally toward the shaft of the bone; it has a long lower border and an upper border about half as long. At the upper end of the shaft, at the union of this with the neck are two large, strong processes, the trochanters. The *greater trochanter* is much larger than the lesser one and looks laterally. Its upper extremity, whose tip is slightly bent posteriorly and medially, projects above the neck and bears on the medial surface below the apex a *trochanteric fossa.* The great trochanter forms the entire lateral part of the upper extremity of the femur. The *lesser trochanter* is opposite the greater on the medial surface of the upper part of the femur and is a short conical projection directed medially and slightly backward; it lies at a somewhat lower level than the great trochanter. The two trochanters are connected on the anterior surface of the bone by a rough *intertrochanteric line,* and on the posterior surface by a distinct ridge, the *intertrochanteric crest.*

The *shaft (corpus)* of the femur is almost cylindrical, but toward its lower end it broadens and becomes triangular-prismatic with rounded borders. In this region there is an anterior medial, an anterior lateral and a posterior surface. It is distinctly convex anteriorly.

While the anterior and lateral surfaces of the bone are exceptionally smooth, the posterior surface shows a rough line, the *linea aspera.* This possesses two distinct lips, a medial and a lateral. Throughout the middle portion of the bone both lips lie close together, but above they diverge toward the two trochanters and below toward the epicondyles (see below). The *lateral lip* passes above into an elongated roughened ridge, the *gluteal tuberosity,* which is occasionally greatly enlarged to form the so-called *third trochanter.* The *medial lip* becomes less pronounced in its upper part and unites with the intertrochanteric line in the region of the lesser trochanter, without actually uniting with this latter, and so ends on the greater trochanter. Parallel with and somewhat lateral to it is a second rough line, the *pectineal line,* which passes upward toward the lesser trochanter.

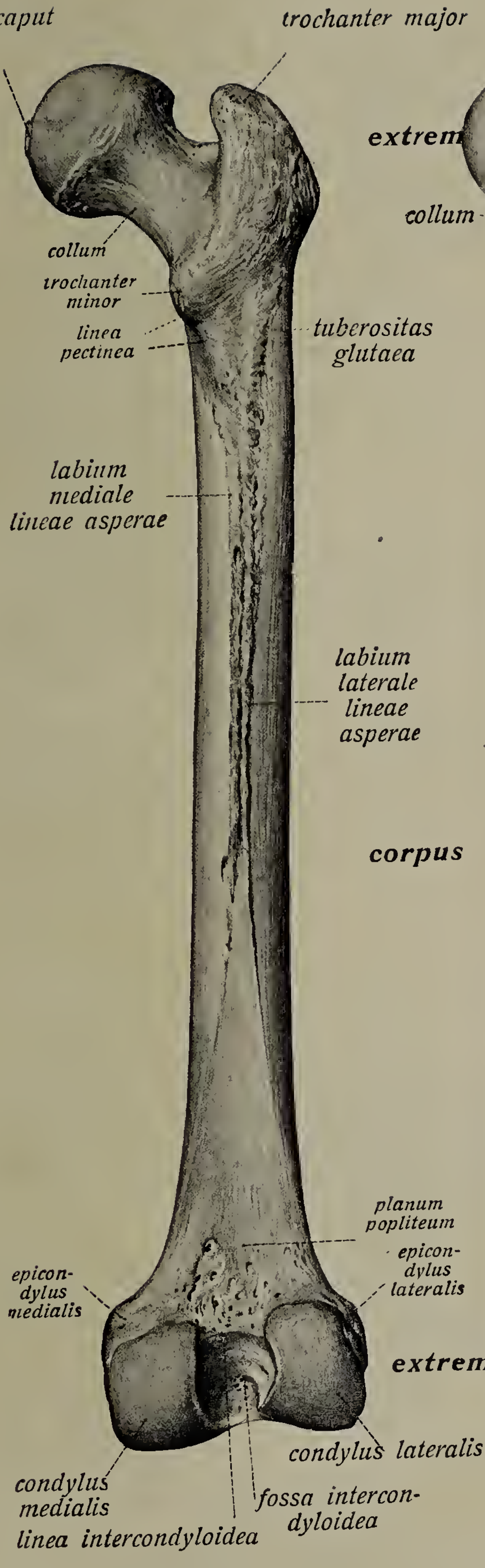


Fig. 139.

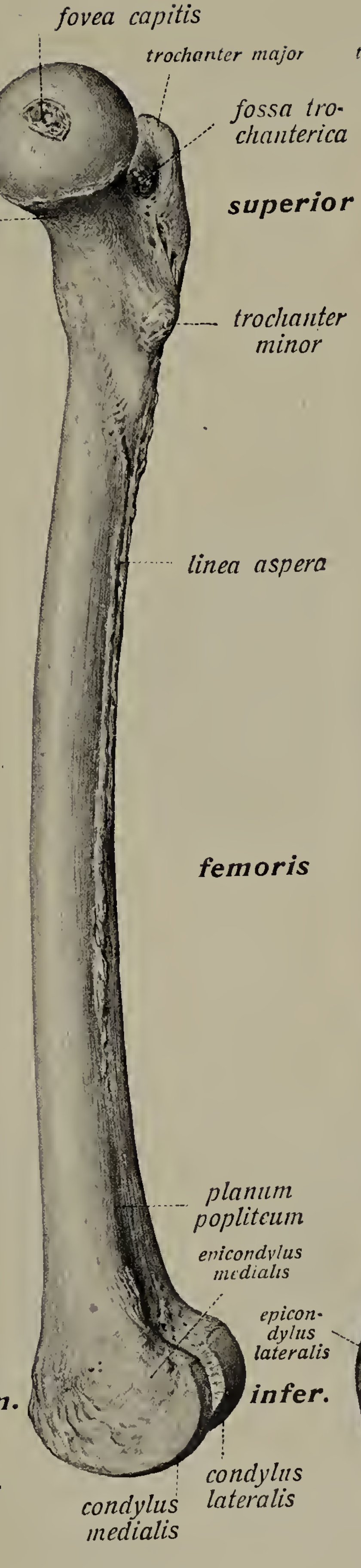


Fig. 140.

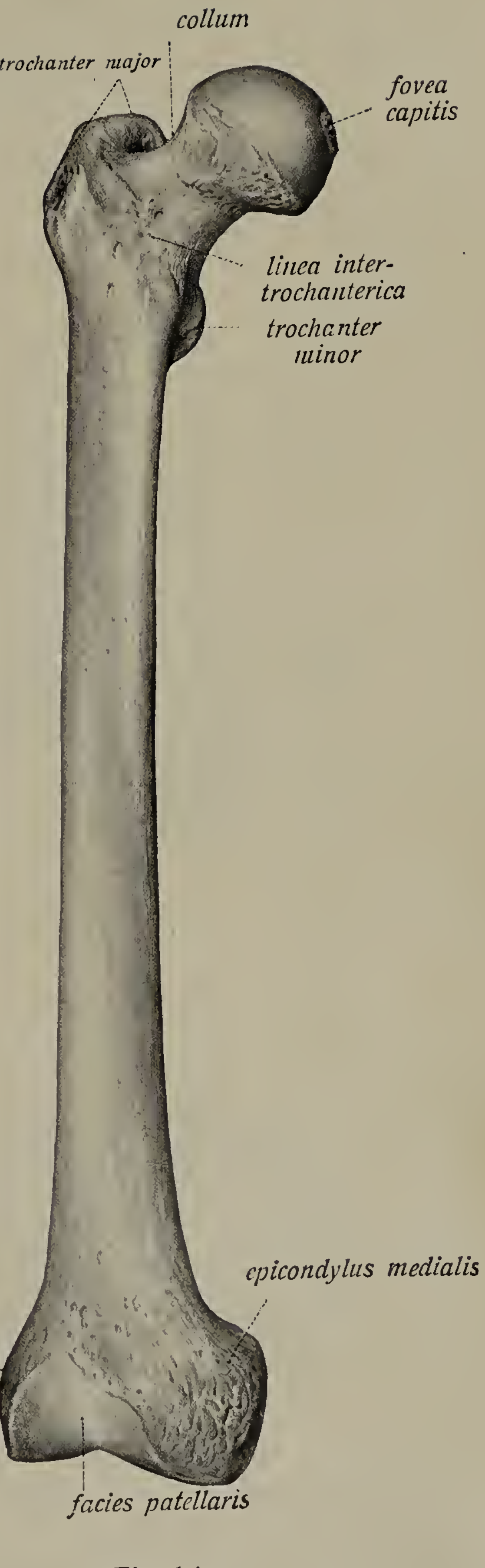


Fig. 141.

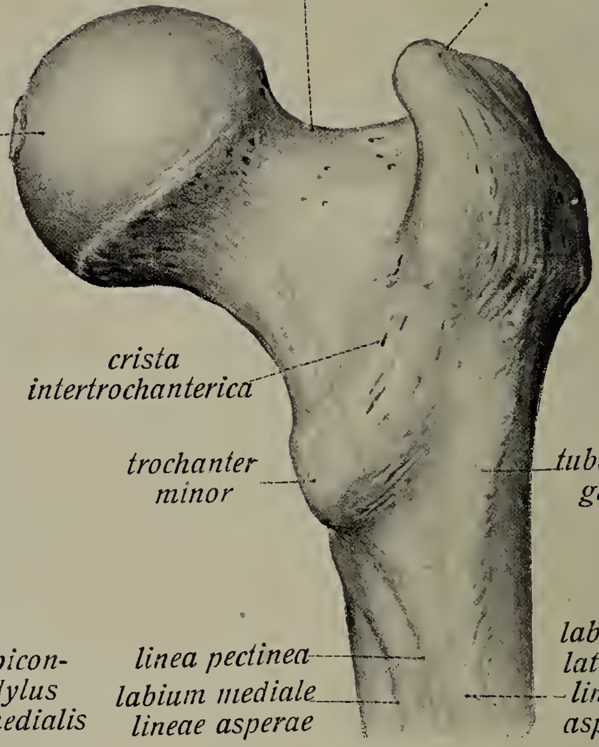


Fig. 142.

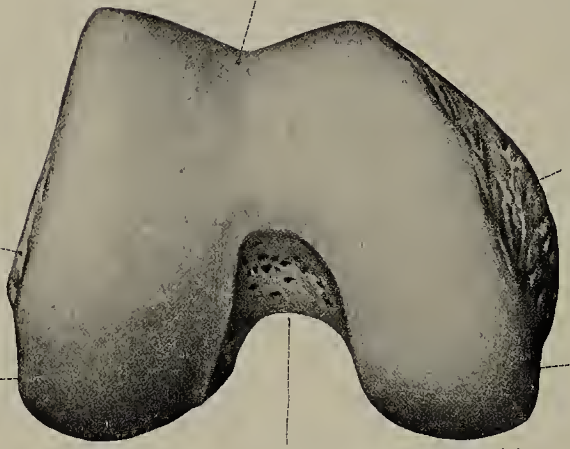


Fig. 143.

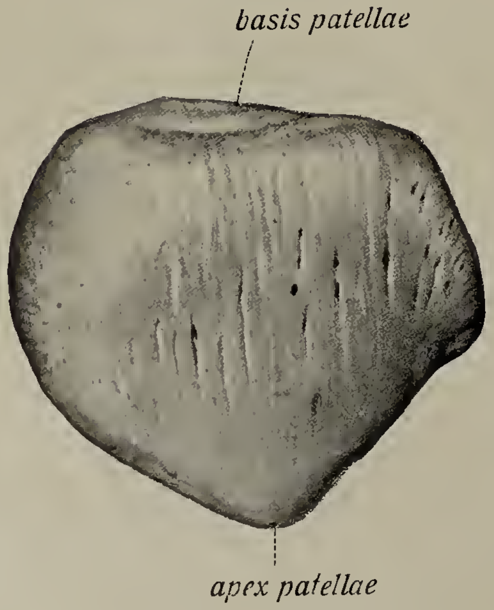


Fig. 144.

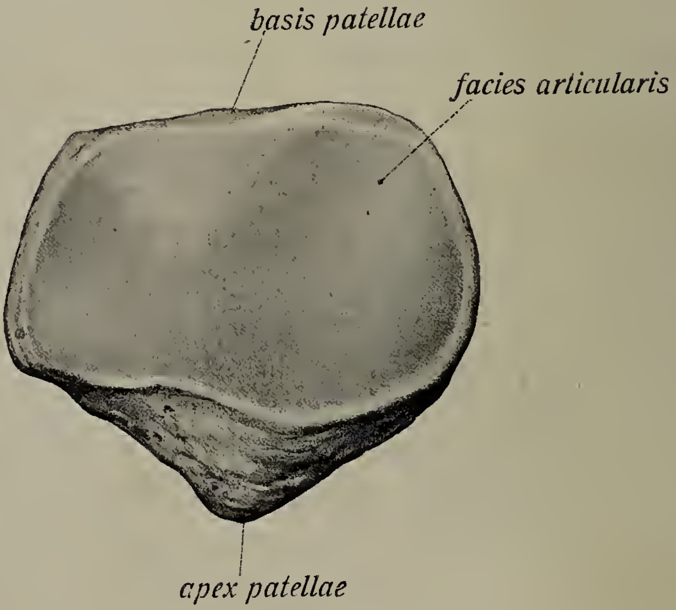


Fig. 145.

The Femur (Cont.) and the Patella.

Fig. 142. Upper extremity of the femur from behind. ($^1/_2$)
Fig. 143. Lower extremity of the femur from below. ($^1/_2$)
Fig. 144. The patella from in front. ($^1/_1$)
Fig. 145. The patella from behind. ($^1/_1$)

Towards the lower end of the femur the two lips of the linea aspera gradually diverge from one another to bound a triangular, almost flat area on the posterior surface of the bone; this is the *popliteal plane.* Upon the linea aspera, above its middle, there is usually one or several *nutrient foramina,* that lead into canals directed distinctly proximally.

The *inferior extremity* of the femur is much broadened. It bears the two convex, backwardly directed articulating condyles, the larger *medial condyle* and the smaller *lateral condyle,* separated from one another behind by the *intercondyloid fossa.* The *intercondyloid line* separates the intercondyloid fossa from the popliteal plane. Anteriorly the cartilaginous surfaces of the condyles pass into a common articular surface, the *patellar surface,* which is concave transversely and convex sagittally; consequently, the whole cartilaginous surface at the lower end of the femur has a horse-shoe shape. Above the condyles are two rough, but only slightly prominent, processes, the *medial* and *lateral epicondyles.*

The Patella.

The *patella* is a flat disk-shaped bone, which is really a large sesamoid bone in the tendon of the quadriceps femoris. Its upper border is broad and is termed the *base,* while below the bone passes into a point, the *apex.* The anterior surface is rough, the posterior smooth and in $^2/_3$ of its extent covered with cartilage, this area taking part in the formation of the knee-joint and being called the *articular surface.* The posterior surface of the apex is not covered with cartilage but is rough like the anterior surface.

The Tibia.

Fig. 146. The right tibia from in front. ($^2/_5$)
Fig. 147. The right tibia from behind. ($^2/_5$)
Fig. 148. The right tibia from the side. ($^2/_5$)

The *tibia* is the medial and the larger of the two bones of the lower leg. It has a *superior extremity*, a shaft *body (corpus)* and an *inferior extremity*.

The *superior extremity* is much the thickest portion of the bone. It bears medial and lateral condyles for articulation with the condyles of the femur. Their upper surfaces are the slightly concave *medial* and *lateral superior articular surfaces* which are separated by a median elevation, the *intercondyloid eminence*, surmounted by two tubercles, the *medial* and *lateral intercondyloid tubercles*. Both behind and in front of the eminence is a small shallow groove the *anterior* and *posterior intercondyloid fossae*. Below the articular surfaces there is the rough, almost perpendicular border of the upper part of the bone, the *infraglenoid border*, and on the lateral and posterior part of this is an articular surface for the head of the fibula. Below the infraglenoid border on the anterior surface of the bone is a large roughened area, the *tuberosity*.

The shaft *(corpus)* of the tibia is distinctly triangular-prismatic. It is thick in its upper part, becomes gradually thinner lower down and then enlarges again below. It presents three surfaces and three borders. The *medial* and *lateral surfaces* are separated by the *anterior crest*, while the very sharp *interosseous crest*, directed toward the fibula, separates the *lateral* and *posterior surfaces*. The third, rounded border, the *medial*, separates the medial and posterior surfaces.

On the upper part of the posterior surface there is an oblique line, the *popliteal line*, which runs from the articular surface for the fibula downwards and medially to the medial border. Below this line is the *nutrient foramen*, usually large and distinct; it leads into a canal that runs obliquely downwards. The *medial surface*, like the anterior border, is subcutaneous and readily felt; the *lateral surface* shows no special markings. Towards the lower end the borders of the bone are rounded so that this part of the shaft is almost cylindrical.

The *inferior extremity*, which is thicker than the lower part of the shaft, is decidedly smaller than the superior extremity. It bears on its under surface a slightly concave *inferior articular surface* for articulation with the tarsus. On its medial side there is a strongly projecting process, the *medial malleolus*, whose outer surface is also an articular surface for the tarsus and passes without demarcation into the inferior articular surface. On its posterior surface the medial malleolus has a broad *medial malleolar groove* for a muscle tendon. On its lateral surface the lower end of the tibia has a *fibular notch* for articulation with the lower end of the fibula; it is not, however, covered with cartilage.

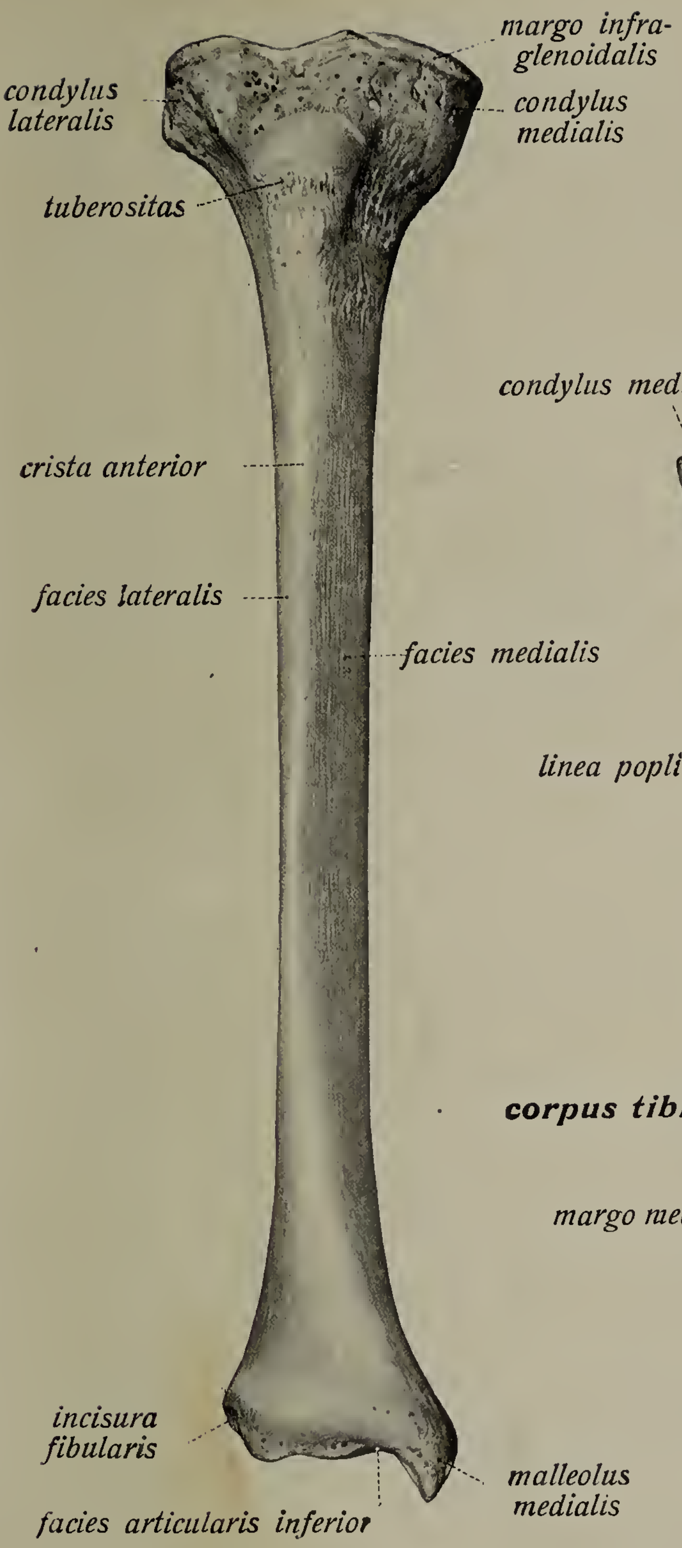


Fig. 146.

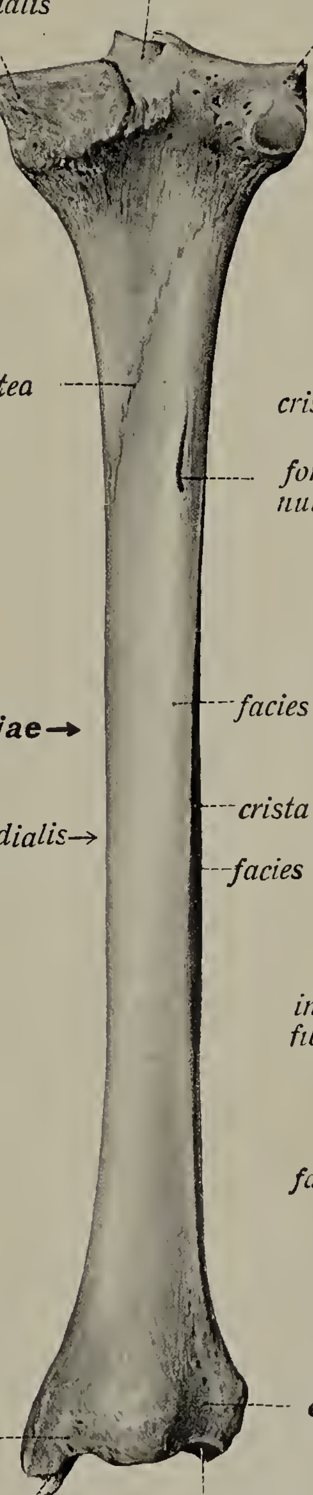


Fig. 147.

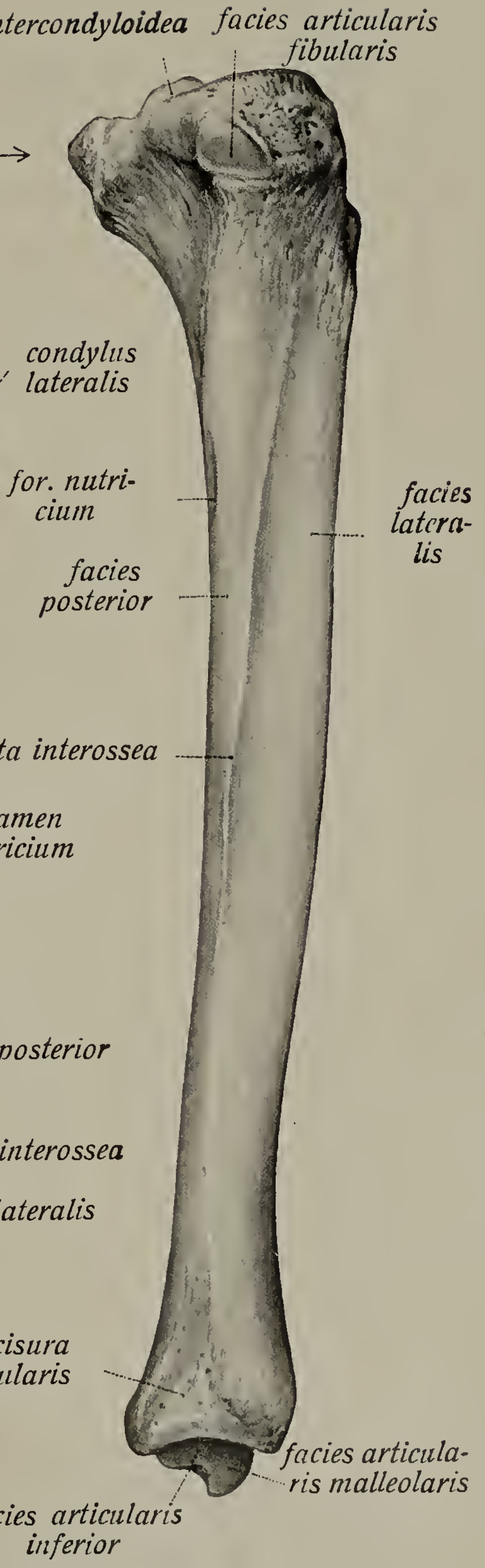

eminentia intercondyloidea
facies articularis fibularis
extremitas superior→
for. nutricium
facies lateralis
facies posterior
crista interossea
incisura fibularis
facies articularis malleolaris
facies articularis inferior

Fig. 148.

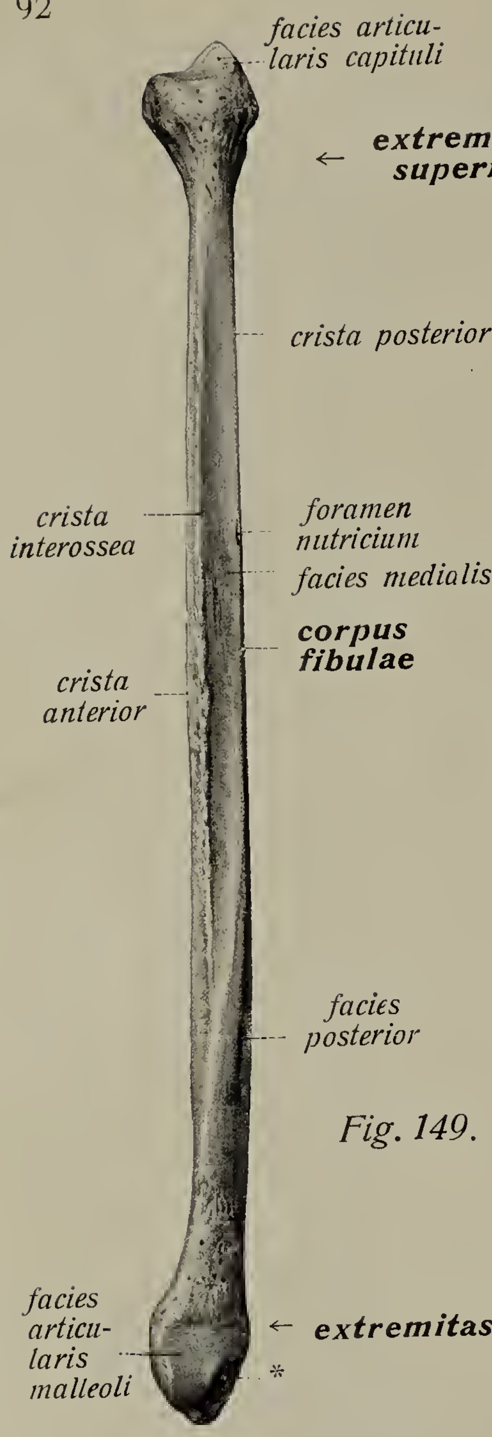


Fig. 149.

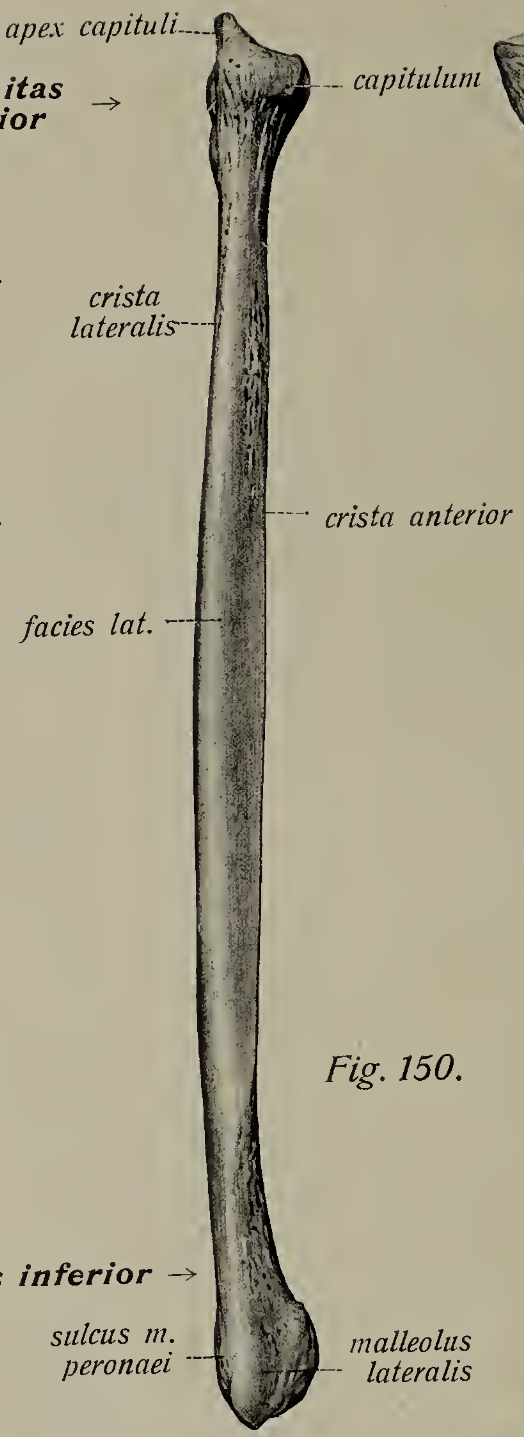


Fig. 150.

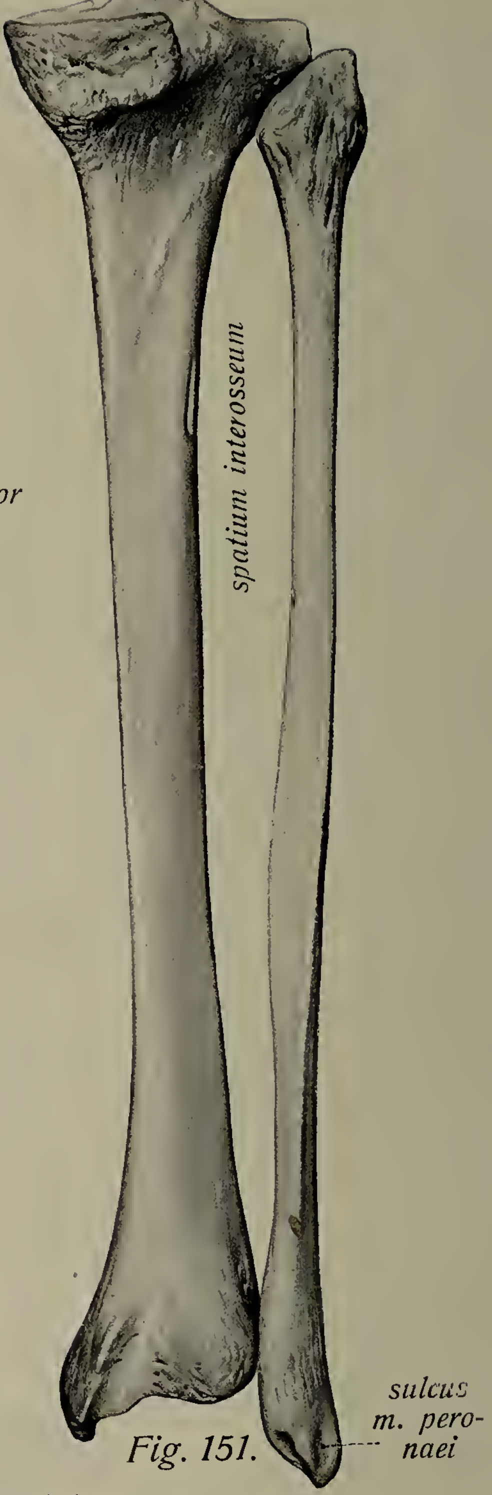


Fig. 151.

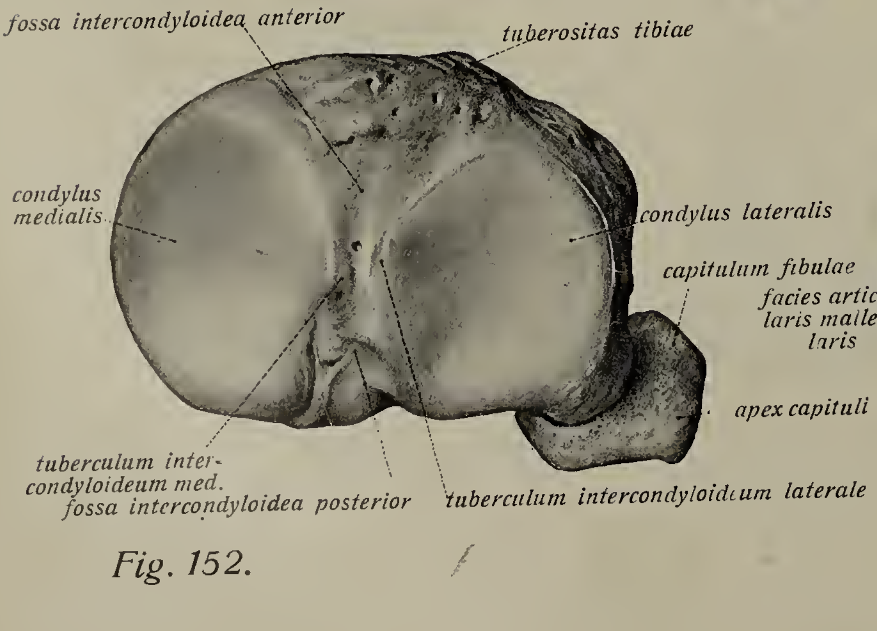

fossa intercondyloidea anterior
tuberositas tibiae
condylus medialis
condylus lateralis
capitulum fibulae
apex capituli
tuberculum intercondyloideum med.
fossa intercondyloidea posterior
tuberculum intercondyloideum laterale

Fig. 152.

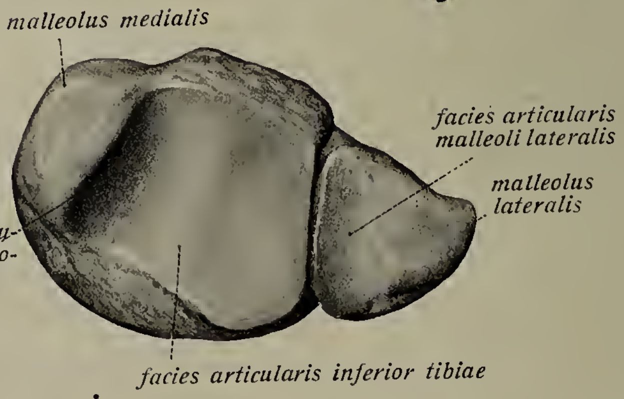

malleolus medialis
facies articularis malleoli lateralis
malleolus lateralis
facies articularis malleolaris
facies articularis inferior tibiae

Fig. 153.

The Fibula.

Fig. 149. The right fibula, medial surface. $({}^{2}/_{5})$
* = fovea for the ligaments arising from the lateral malleolus.
Fig. 150. The right fibula, lateral surface. $({}^{2}/_{5})$
Fig. 151. The tibia and fibula from behind. $({}^{2}/_{5})$
Fig. 152. The upper ends of the tibia and fibula from above. $({}^{1}/_{2})$
Fig. 153. The lower ends of the tibia and fibula from below. $({}^{1}/_{2})$

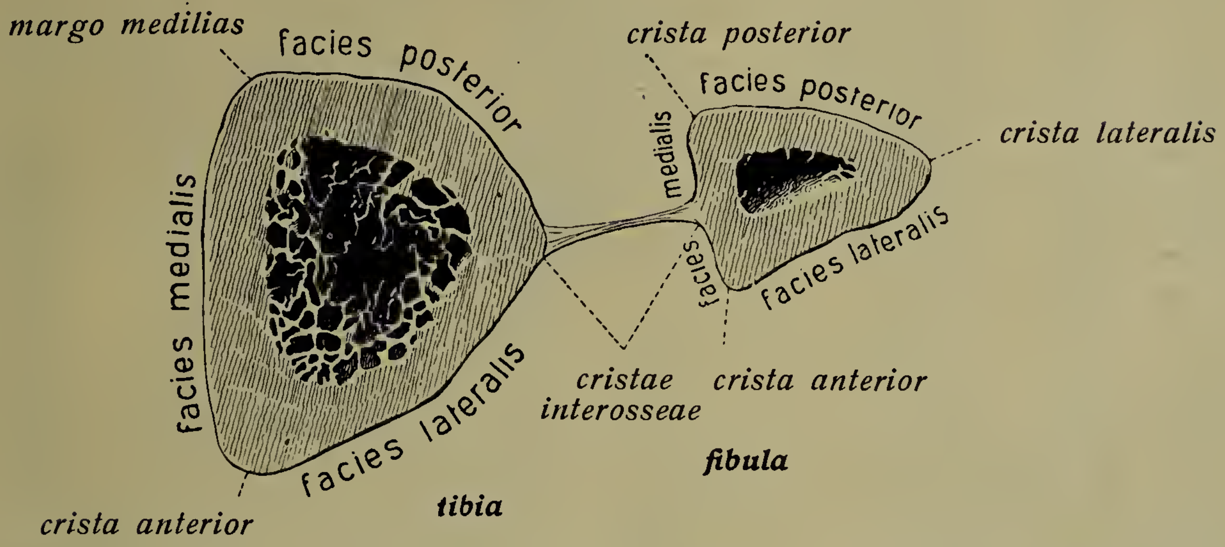


Fig. 154. The bones of the left lower leg cut across about the middle of their length (Schematized).

The *fibula* is a long bone, very thin in proportion to its length; it is scarcely shorter than the tibia, beyond which it projects below. It lies on the lateral side of the lower leg and has a *superior extremity*, a shaft *(corpus)* and an *inferior extremity*. The superior extremity forms the head *(capitulum)* and the inferior extremity the *lateral malleolus*. The head is distinctly enlarged as compared with the slender shaft; its uppermost part is behind and somewhat lateral and is termed the *apex*. It bears, for articulation with the tibia, a small, almost flat surface, the *capitular articular surface*.

The *shaft* is very distinctly triangular-prismatic. The three surfaces are medial, lateral and posterior, the sharp borders, which are not always straight are termed *crests*. The *anterior crest* separates the medial and lateral surfaces, the *posterior crest* the posterior and medial surfaces and the *lateral crest* the posterior and lateral surfaces. In addition to these there is a feebly developed *interosseous crest* at about the middle of the medial surface, so that the fibula has really four borders.

The inferior extremity forms the *lateral malleolus*. This is longer and more pointed than the medial one and has upon its medial surface an *articular surface*, which immediately adjoins the inferior articular surface of the tibia. On the lateral surface of the malleolus there is a shallow groove for the peroneal tendons.

The Bones of the Right Foot.

The Skeleton of the Foot as a Whole and the Tarsus.

Fig. 155. The bones of the foot, plantar surface. ($^2/_3$)
Fig. 156. The bones of the foot, dorsal surface. ($^2/_3$)

Like the hand, the foot consists of three portions: 1. *the tarsus,* 2. *the metatarsus* and 3. the *phalanges,* but it differs from the hand not only in the number and form of its constituent bones, but also in certain special particulars. While the axis of the hand is the direct continuation of that of the forearm and arm, that of the foot is almost at right angles to that of the leg, and while in the hand the fingers are almost the half of its entire length, in the foot the tarsus forms almost the proximal half and the metatarsals and toes the distal half, the latter being only a fifth of the entire length of the foot.

The foot is more strongly arched than the bones of the hand and the arch is less capable of being modified. Its convexity is dorsal and the concavity plantar, the deepest point of the latter being at the sharp, lower edge of the second cuneiform bone. Similarly the dorsal surface of the second cuneiform is the highest point of the middle of the arch. The lower supports for the arch are the calcaneal tuberosity behind and the heads of the metatarsals in front. It is formed exclusively by the tarsus and metatarsus and is open medially, since the medial border of the foot is much higher than the lateral, which rests on the ground through almost its entire length.

The phalanges of the second to the fifth toes do not lie in a single plane, even when the toes are extended, but are strongly convex upwards and seem to be curved in a claw-like manner upon the heads of the metatarsal bones, so that only their distal ends are in contact with the ground. The second toe is the longest and is that through which the axis of the foot passes.

The Tarsus.

There are seven tarsal bones: 1. the *talus (astragulus),* 2. the *calcaneus,* 3. the *navicular,* 4. the *cuboid* and 5—7 the three *cuneiform* bones, the first or internal, the second or middle and the third or outer. The arrangement of these bones is such that on the medial side of the foot there are three bones, the talus, navicular and cuneiform, whereas on the lateral side there are only two, the calcaneus and cuboid. In contrast to the condition in the hand only a single bone, the talus, articulates with the lower leg bones.

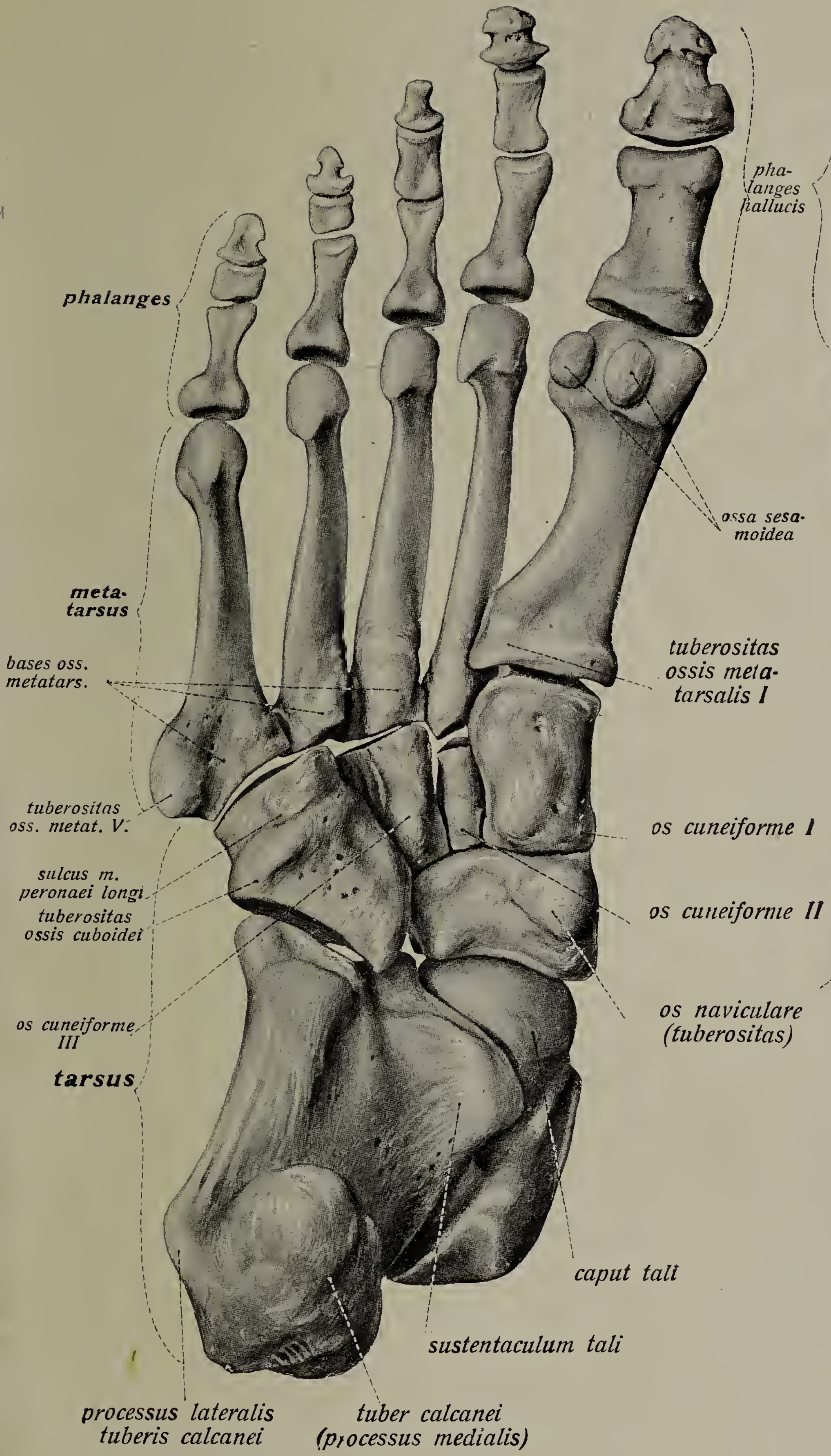


Fig. 155

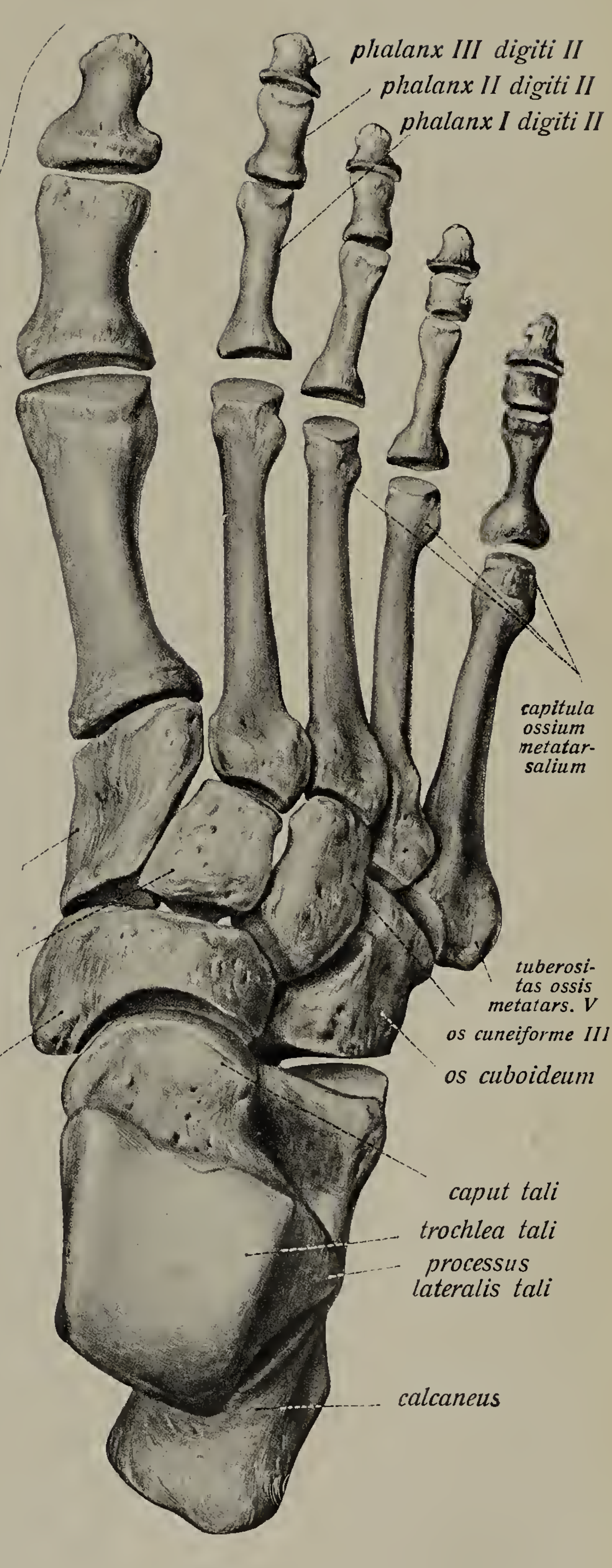


Fig. 156.

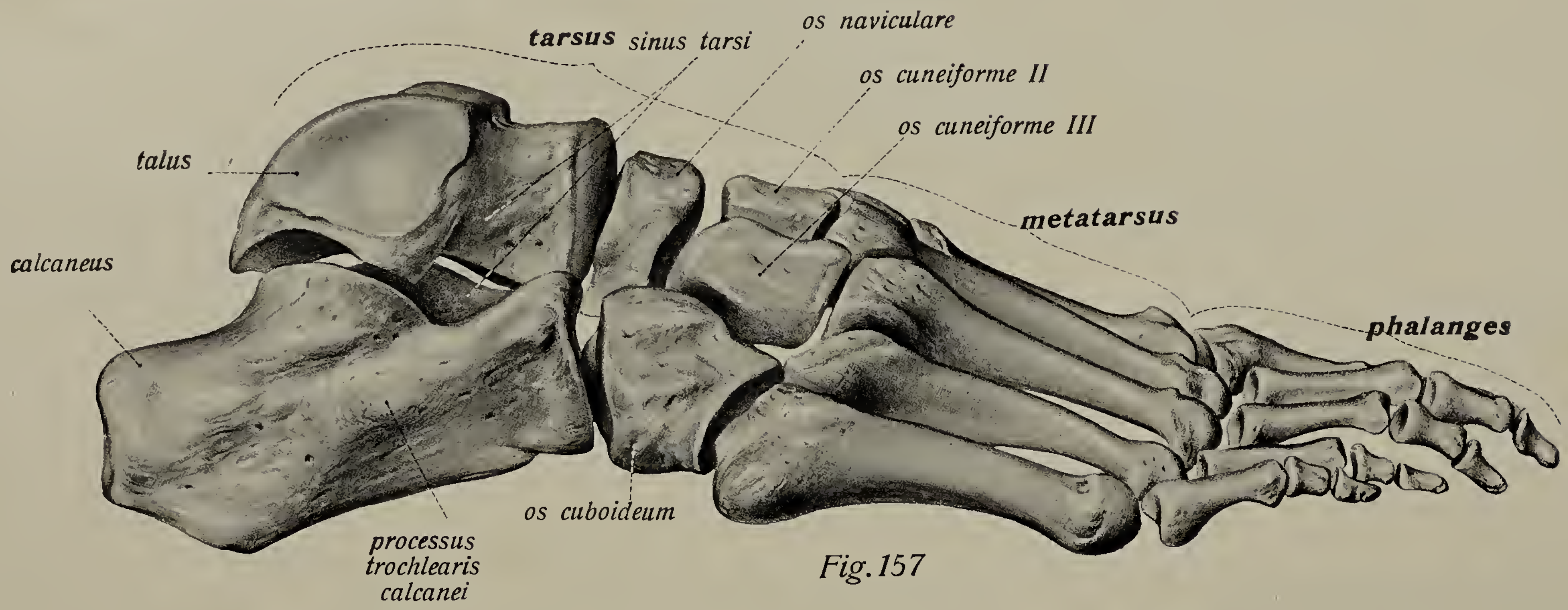


Fig. 157

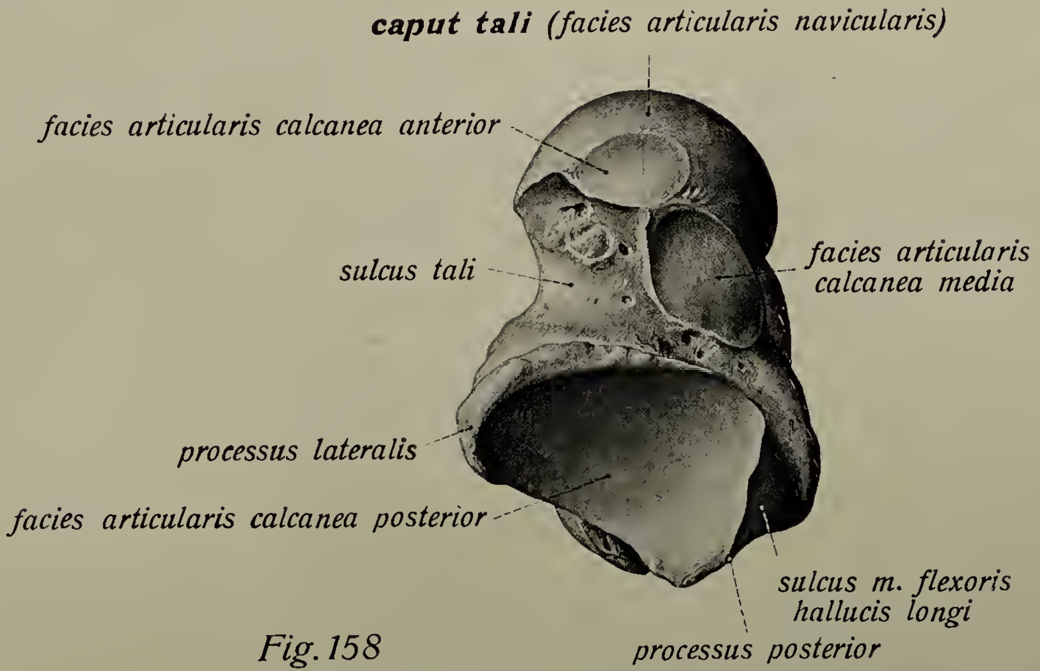

caput tali (facies articularis navicularis)
facies articularis calcanea anterior
sulcus tali
facies articularis calcanea media
processus lateralis
facies articularis calcanea posterior
sulcus m. flexoris hallucis longi
processus posterior

Fig. 158

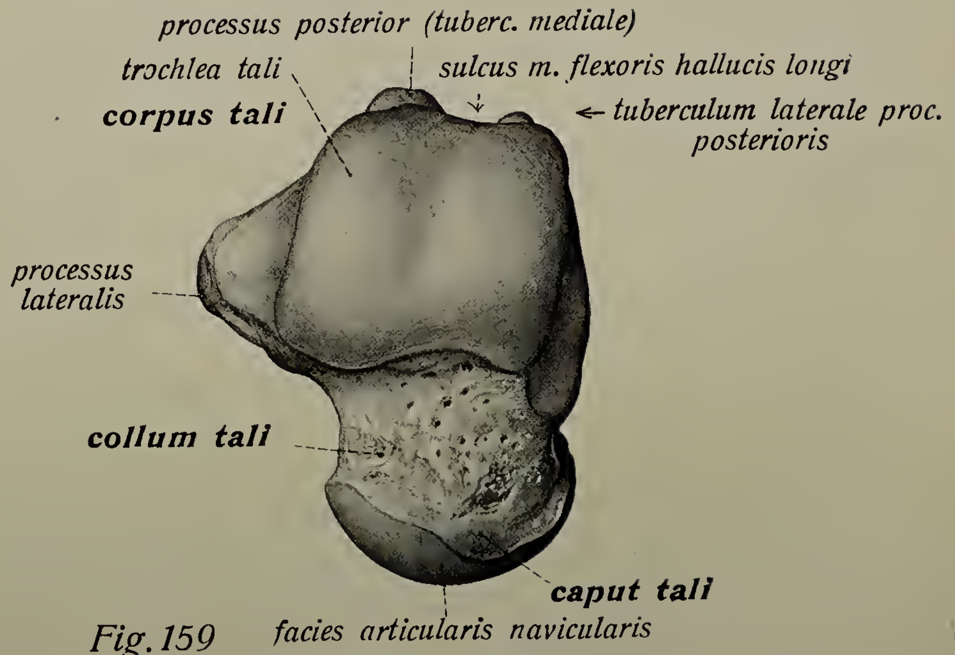

processus posterior (tuberc. mediale)
trochlea tali
sulcus m. flexoris hallucis longi
corpus tali
← tuberculum laterale proc. posterioris
processus lateralis
collum tali
caput tali
facies articularis navicularis

Fig. 159

The Tarsus. (Cont.)

The *talus* is a short bone with an irregular cubical form, and presents for examination *a body (corpus),* a *head (caput)* and a constricted portion between these, the *neck (collum).* The body is the thickest and most posterior part of the bone and bears on its upper surface an articular surface, the *trochlea,* covered with cartilage and articulating with the tibia and fibula. The trochlea extends also upon the lateral surface of the talus and upon a strong projection of the bone, the *lateral process*, forming the *lateral malleolar surface;* it extends also upon the medial surface forming the *medial malleolar surface,* but this is smaller in extent than the lateral one, a part of the medial surface being rough. Behind the trochlea is a backwardly projecting part of the bone, the *posterior process,* which bears a broad groove for the tendon of the flexor hallucis longus. The under surface of the body bears a distinctly concave *posterior calcaneal articular surface,* in front of which is a broad depression, the *sulcus tali.* Anterior to this, in the region of the neck, there is on the under surface an elongated second articulation for the calcaneus, the *middle calcaneal articular surface,* and adjoining this, on the head of the talus is an *anterior calcaneal articular surface.* The constricted *neck (collum)* is to be seen distinctly only on the upper and lateral surfaces; on the medial and lower surfaces it is clearly separated from neither the head nor body. The *head (caput)* is the rounded anterior end of the bone and bears the almost hemispherical *navicular articular surface,* for articulation with the navicular bone and navicular fibro-cartilage.

The *calcaneus* is the largest bone of the tarsus. Its principal part is termed the *body (corpus),* the posterior thickened end of which is termed the *tuberosity (tuber calcanei)* and projects backwards behind the other bones of the foot. On its under surface are two projections, the *medial* and *lateral processes.* Looking from above one sees three surfaces (posterior, middle and anterior) for articulation with the talus; the posterior is the largest and is convex, the other two are slightly concave. Between the middle and posterior articular surfaces lies the *calcaneal groove,* which is broadly open laterally; with the sulcus tali it forms the *sinus tarsi.*

Fig. 157. The bones of the foot from the inner side. ($^2/_3$)
Fig. 158. The right talus from below. ($^4/_5$)
Fig. 159. The right talus from above. ($^4/_5$)

The Tarsus, Metatarsus and Phalanges.

Fig. 160. The right calcaneus, medial surface. ($^4/_5$)
Fig. 161. The right calcaneus, lateral surface. ($^4/_5$)
Fig. 162. The right calcaneus from above. ($^4/_5$)
Fig. 163. The right navicular from behind. ($^1/_1$)
Fig. 164. The right navicular from in front. ($^1/_1$)
Fig. 165. The right cuboid, medial surface (see also Fig. 155). ($^1/_1$)
Fig. 166. The right internal cuneiform from in front. ($^1/_1$)
Fig. 167. The right middle cuneiform from behind. ($^1/_1$)
Fig. 168. The right external cuneiform from behind. ($^1/_1$)
(The bones that are in contact with the articular surfaces are named in parentheses.)

From the strongly concave medial surface of the calcaneus a broad process, the *sustentaculum tali,* projects towards the talus and bears the middle articular surface for that bone. On its under surface is the broad groove for the tendon of the flexor hallucis longus, continuous with the similar groove on the talus. A similar, but much shallower, groove for the peroneal muscles lies on the lateral surface, which is otherwise flat, except that a small, blunt *trochlear process* sometimes occurs above the groove. The anterior surface bears the articular surface for the cuboid, which is somewhat saddle-shaped.

The *navicular* lies between the talus behind and the three cuneiforms in front. Its long axis is transverse to that of the foot and it is convex anteriorly and concave posteriorly, and its dorsal surface is also distinctly convex. On its plantar surface, near the medial border, there is a strong rounded projection, the *tuberosity.*

The *cuboid* lies on the lateral border of the foot, between the anterior end of the calcaneus and the bases of the fourth and fifth metatarsals. It has an irregular cubical form, tapering toward the lateral border of the foot. Its anterior surface bears an articulating surface divided into two parts for the fourth and fifth metatarsals; its posterior surface is saddle-shaped and its medial surface has an articular facet for the external cuneiform. The plantar surface has a flat projection, the *tuberosity,* which is rounded and sometimes covered with cartilage; it serves as a pulley for the tendon of the peroneus longus, which lies in a groove, the *peroneal groove,* in front of the tuberosity.

The *cuneiform* bones are wedge shaped; the internal one is the largest and has its sharp edge dorsally, while in the others it is turned plantarwards. The middle one is the smallest. They articulate with the navicular behind and the bases of three metatarsals in front; the internal one usually articulates also with the cuboid.

The Metatarsals.

The *metatarsals* have each a *base,* a head *(capitulum)* and a body (corpus). They lie between the bones of the tarsus behind and the phalanges in front; articulating with both. In addition the bases of the second to the fifth articulate with each other. The first metatarsal is short and thick; the second is the longest. The base of the first has a broad tuberosity directed plantarwards and laterally, and a tuberosity also occurs on the base of the fifth which projects markedly upon the lateral border of the foot.

The *phalanges* resemble those of the hand but are markedly shorter. The great toe has two phalanges, which are much thicker than those of the other toes. Each phalanx has a base, a body and a trochlea, this on the terminal phalanges being replaced by an unguicular tuberosity.

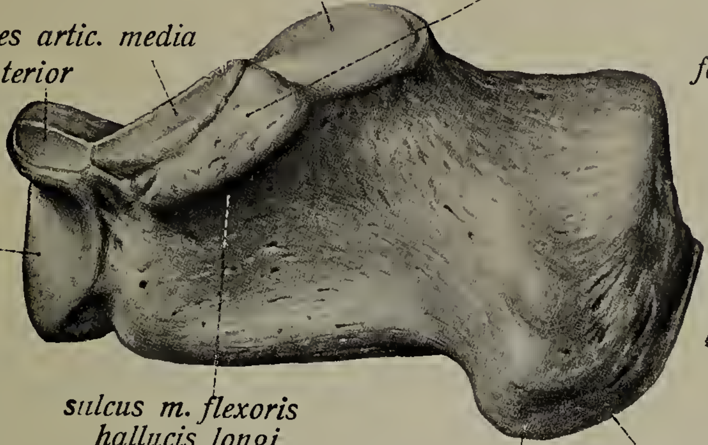

facies articularis posterior
sustentaculum tali
facies artic. media
facies artic. anterior
facies articularis cuboidea
sulcus m. flexoris hallucis longi
tuber calcanei
proc. medialis tuberis calcanei

Fig. 160.

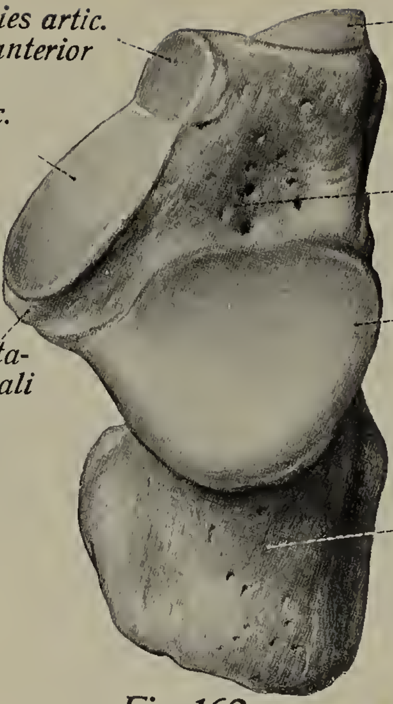


Fig. 162.

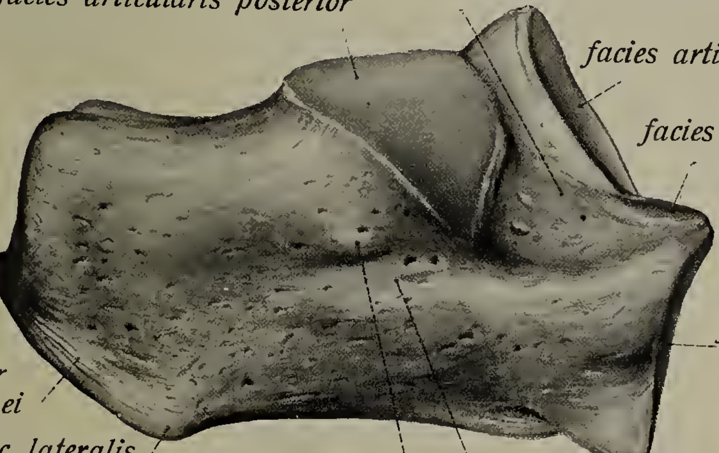


Fig. 161.

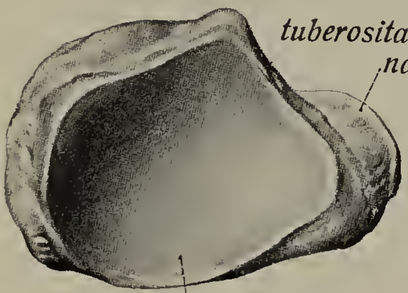

tuberositas ossis navicularis
facies articularis (caput tali)

Fig. 163.

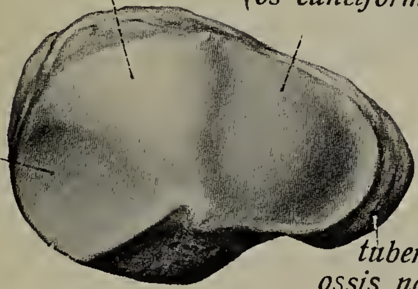

facies artic. (os cuneiforme II)
facies articularis (os cuneiforme I)
facies articularis (os cuneif. III)
tuberositas ossis navicularis

Fig. 164.

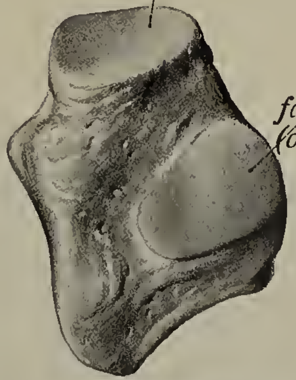

facies articularis (ossa metatarsalia IV und V)
facies articularis (os cuneiforme III)

Fig. 165.

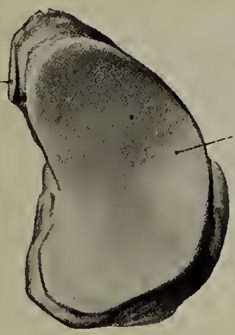

fac. art. (basis ossis metatarsal. II)
fac. art. (basis oss. metatarsal. hallucis)

Fig. 166.

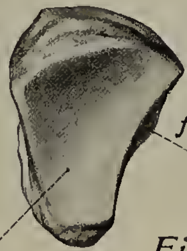

facies articularis (os cuneif. III)
facies artic. (os naviculare)

Fig. 167.

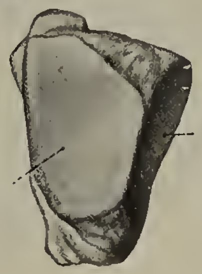

fac. articularis (os cuboideum)
facies artic. (os naviculare)

Fig. 168.

Spongiosa osseum.

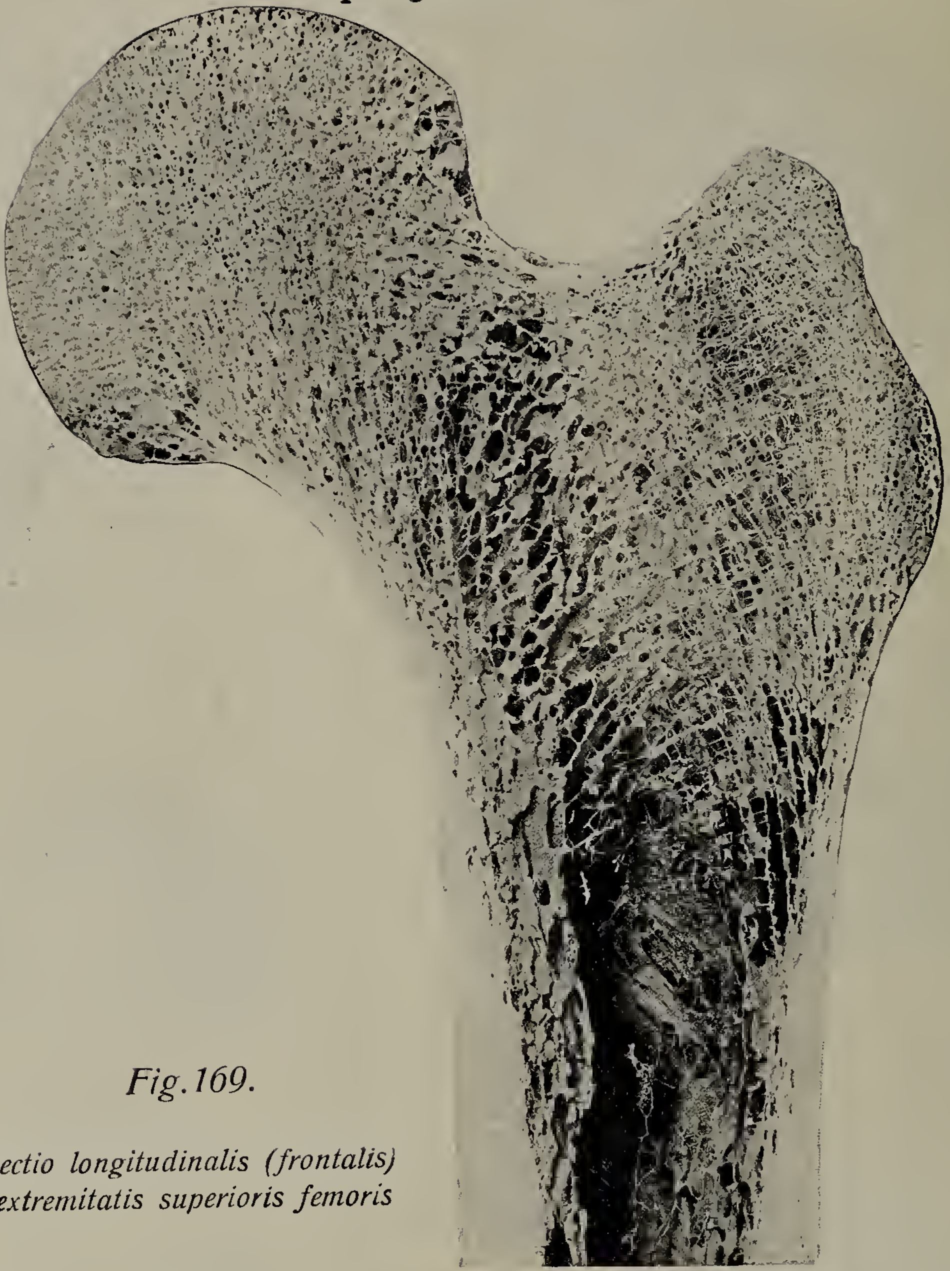
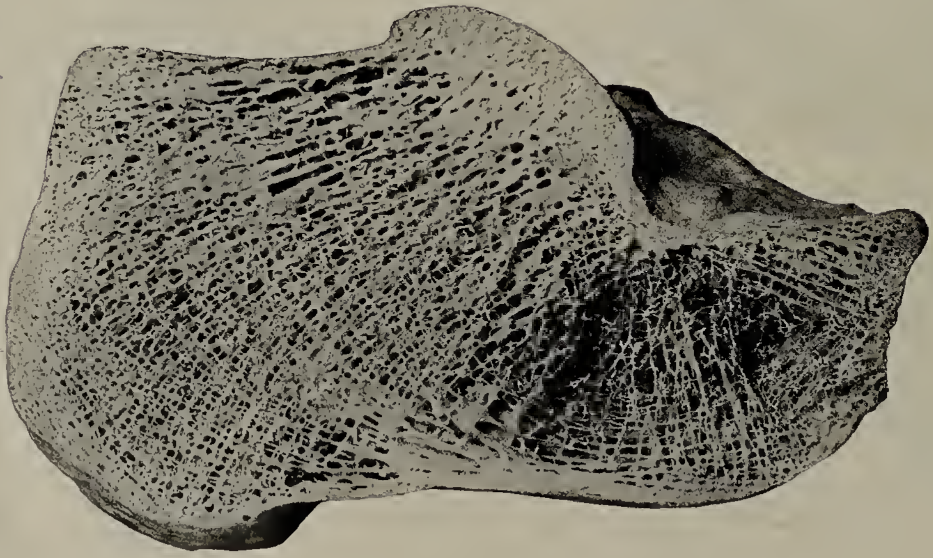


Fig. 169.

sectio longitudinalis (frontalis) extremitatis superioris femoris



sectio longitudinalis (sagittalis) calcanei

Fig. 170.

Spongiosa osseum.

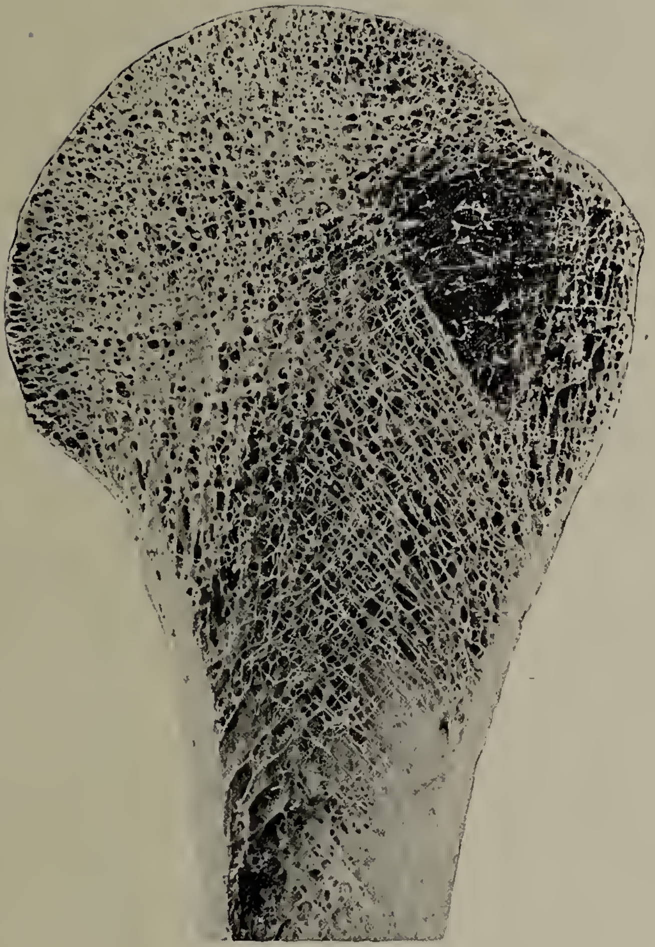


Fig. 171.

sectio longitudinalis (frontalis) extremitatis superioris humeri.

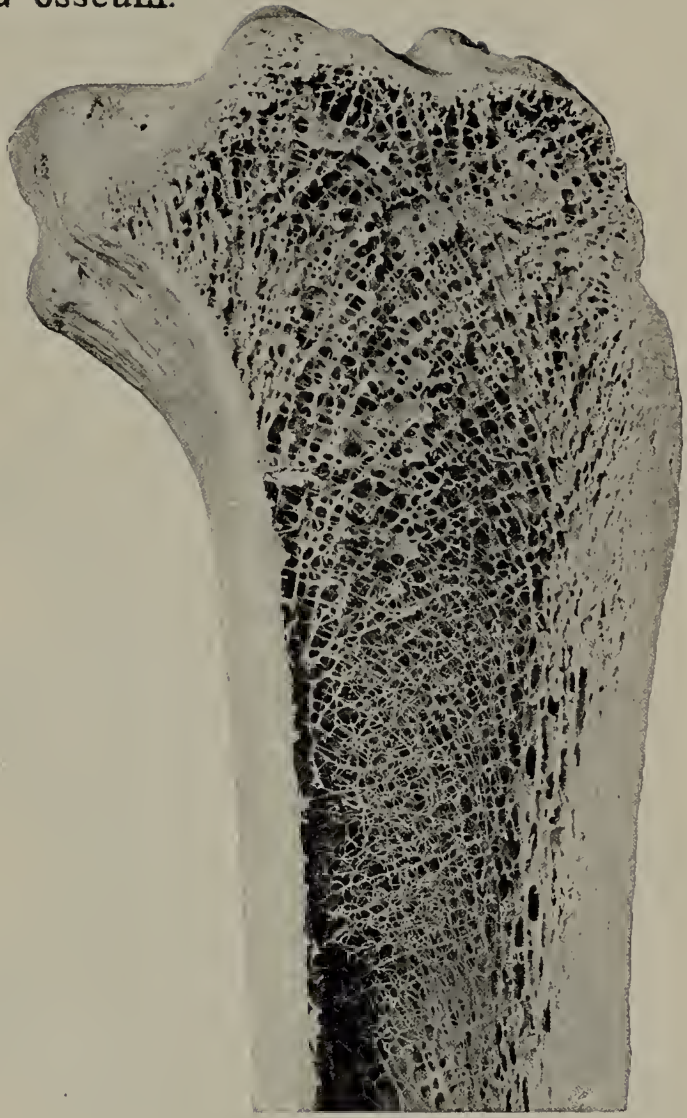


Fig. 172.

sectio longitudinalis (sagittalis) extremitatis superioris tibiae.

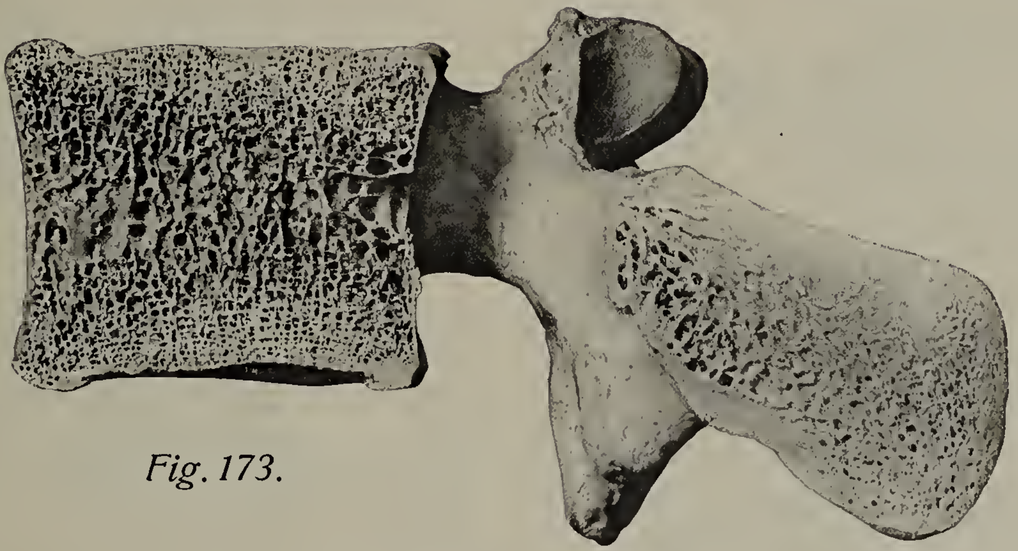


Fig. 173.

sectio sagittalis vertebrae lumbalis.

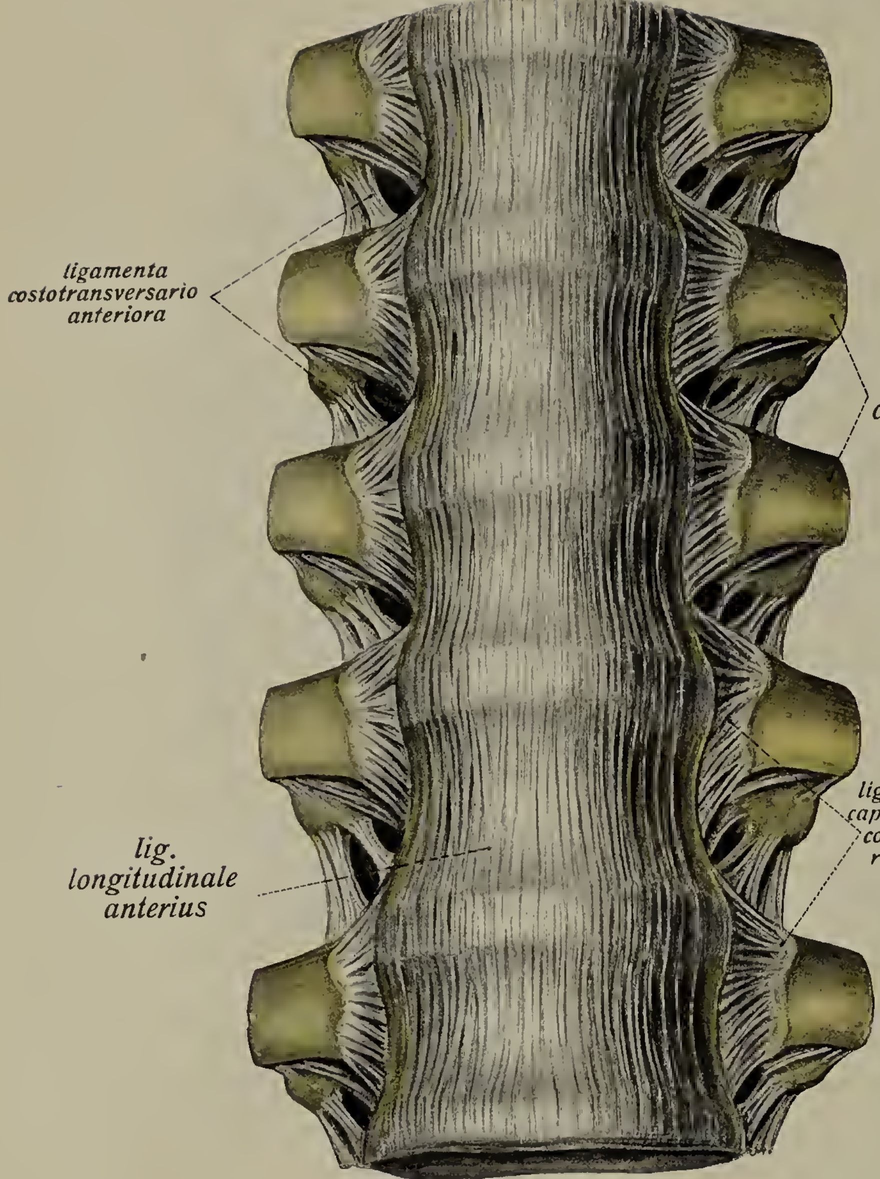

ligamenta costotransversario anteriora
costae
lig. longitudinale anterius
ligamenta capitulorum costarum radiato

Fig. 174.

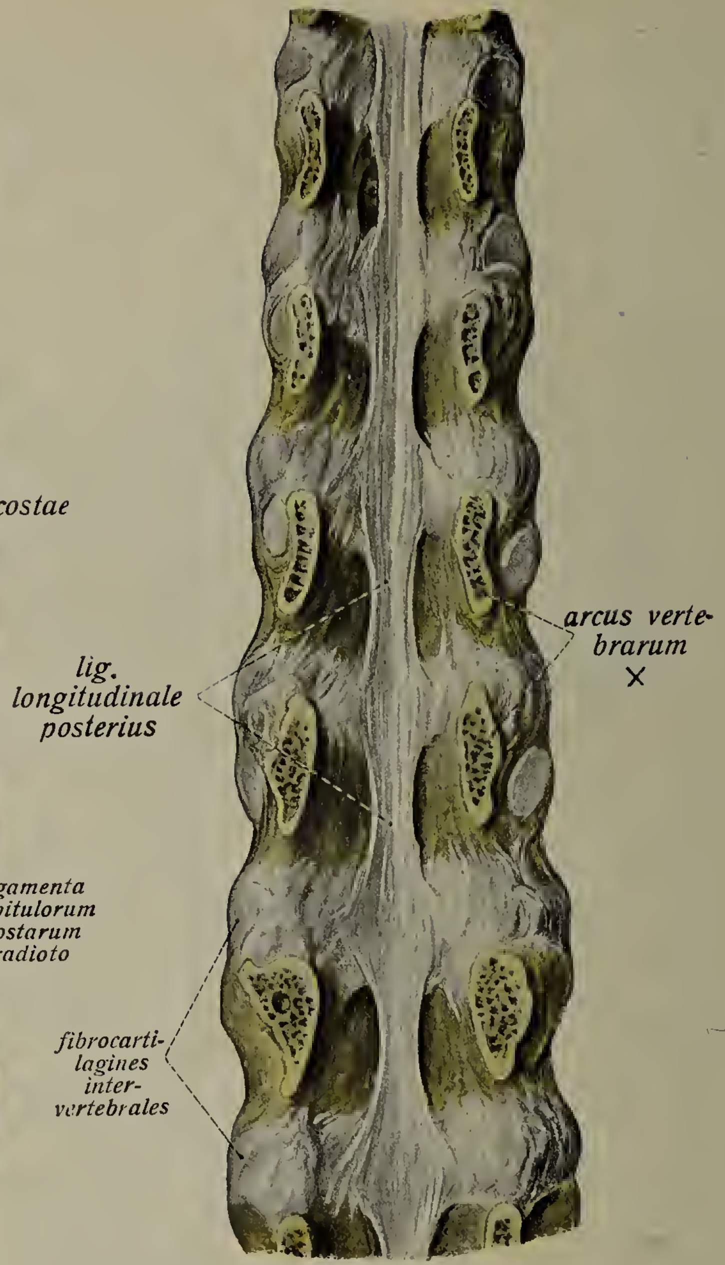

lig. longitudinale posterius
arcus vertebrarum ×
fibrocartilagines intervertebrales

Fig. 175.

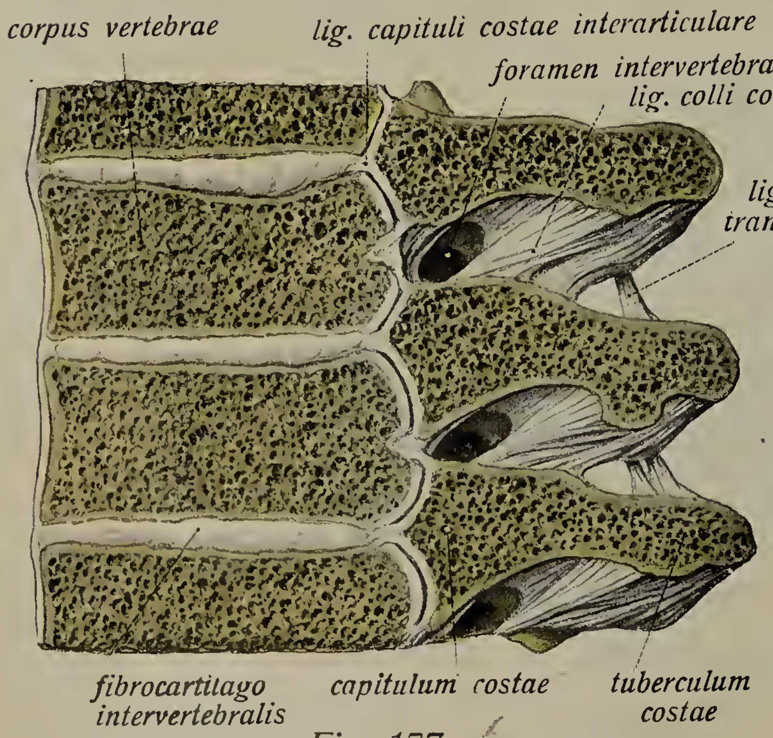

corpus vertebrae
lig. capituli costae interarticulare
foramen intervertebrale
lig. colli costae
ligament. costotransversar. poster.
fibrocartilago intervertebralis
capitulum costae
tuberculum costae

Fig. 177.

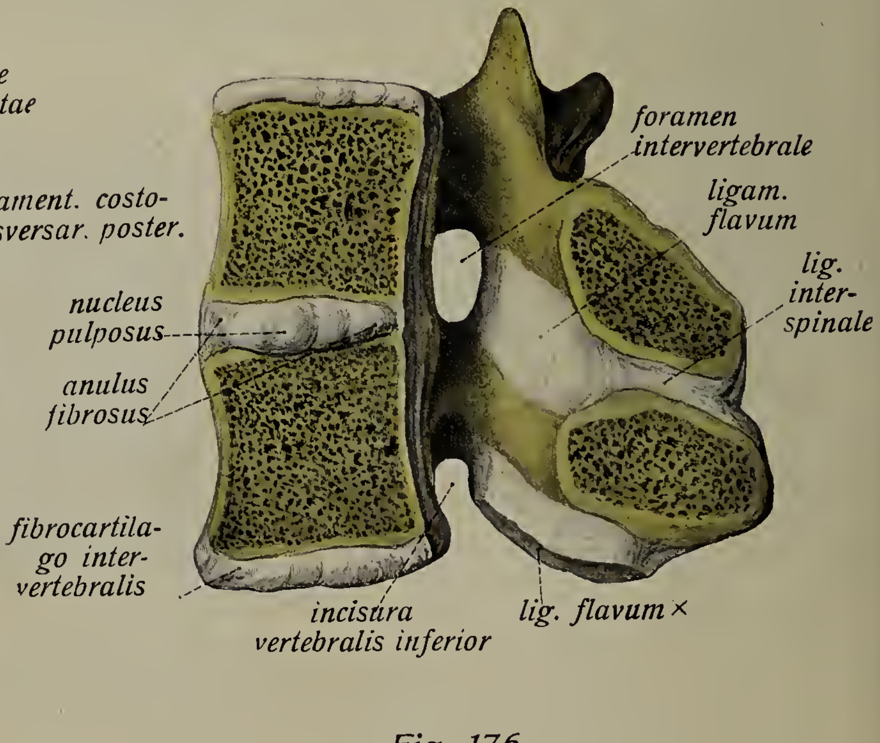


Fig. 176.

Syndesmology.

Joints and Ligaments of the Vertebral Column.

Articulations of the Bodies of the Vertebrae.

Fig. 174. The ligaments of the lower part of the thoracic portion of the vertebral column with the posterior ends of the ribs, from in front. ($^3/_4$)

Fig. 175. The posterior longitudinal ligament in the lower part of the thoracic and the upper part of the lumbar portion of the vertebral column. The arches of the vertebrae have been cut away near their roots. ($^3/_4$)

Fig. 176. Two thoracic vertebrae with their ligaments, divided in the median plane. ($^3/_4$)

Fig. 177. Section through the bodies of the vertebrae, the costo-vertebral articulations and the posterior ends of the ribs. The section is at an angle of 45° with the median plane. ($^3/_4$)

The bodies of the true vertebrae are united by fibrocartilaginous disks, the *intervertebral fibrocartilages*. Each of these consists of a firm ring, *anulus fibrosus,* of interlacing and concentric connective tissue bundles and of a central *pulpy nucleus*. The latter is compressed within the fibrous ring and bulges out when the disk is cut across. The fibrocartilages are in relation to the opposing surfaces of the bodies of adjacent vertebrae, these surfaces being covered by a thin layer of cartilage. The fibrocartilages are larger than the surfaces of the vertebrae between which they lie; their greatest height is at the middle, where they are in relation to the slightly concave surfaces of the vertebrae. There is no disk between the first and second vertrebrae; the first lies between the second and third vertebrae and the last between the fifth lumbar vertebra and the sacrum, so that there are 23 fibrocartilages. In general they increase both in circumference and height from above downwards, just as do the vertebrae. In the cervical region they are, however, smaller but higher than those between the upper and middle thoracic vertebrae; those between the lumbar vertebrae are the largest and highest of all. The lowest fibrocartilages are wedge-shaped being distinctly higher (about $^1/_3$) in front than behind, especially in the case ot the last one, the *promontory*.

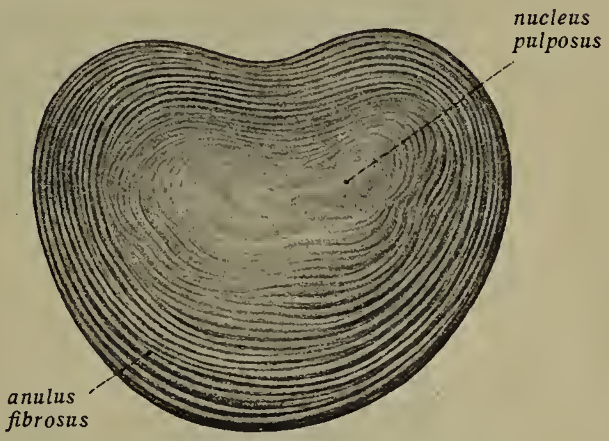


Fig. 178. Horizontal section of a fibrocartilaginous disk.

The Intervertebral Articulations.

In addition to the mixed synarthrotic union of the bodies, the true vertebrae are also connected by *intervertebral articulations*. Each pair of superior articular processes unite with the pair of inferior articular processes of the vertebra next above. Each joint has an *articular capsule,* loose in the cervical vertebrae but compact in the lower ones; it encloses the cartilaginous surfaces. There are no accessory ligaments.

The Ligaments of the Vertebral Column and those between the Ribs and the Vertebrae.

Fig. 179. The ligamenta flava between the arches of the thoracic vertebrae, seen from within; the bodies of the vertebrae have been cut away at the roots of the arches. The ribs have been disarticulated on the left side, but remain in their natural relations on the right. ($^3/_4$)

Fig. 180. The posterior longitudinal ligament and intervertebral fibrocartilages of the lumbar vertebrae. The arches have been cut away at their roots. ($^3/_4$)

Fig. 181. Horizontal section through a thoracic vertebra, showing its costal articulations. ($^1/_1$)

Throughout the whole length of the vertebral column, in the region of the bodies, there is both an *anterior* and a *posterior longitudinal ligament,* covering respectively the anterior and posterior surfaces of the bodies and the intervertebral disks. The anterior one is a broad band, which begins quite small at the anterior tubercle of the atlas and broadens greatly below, where it ends on the anterior surface of the sacrum. It is very closely connected with the intervertebral fibrocartilages, but over the middle of the bodies, whose anterior surfaces are concave, it is more loosely attached. It consists of long superficial and deep fibres passing from vertebra to vertebra.

The *posterior longitudinal ligament* lies on the posterior surface of the bodies. It is much smaller than the anterior one and diminishes in breadth from above downwards. It begins as an independent ligament at the second vertebra, but is continued above this to the skull as the *tectorial membrane;* below it ends in the sacral canal. It broadens distinctly over each intervertebral fibrocartilage and is closely connected with these, but has no attachments to the posterior surfaces of the bodies of the vertebrae.

The ligaments between the arches, *ligamenta flava,* are strong elastic bands, owing their name to their marked yellow color. They completely cover in the intervals between adjacent arches, extending anteriorly to the posterior borders of the capsules of the intervertebral articulations. Consequently they close in the vertebral canal up to the margins of the *intervertebral foramina.* Their inner surfaces are perfectly smooth and form a common surface with the inner surfaces of the arches. On account of their elasticity the posterior wall of the vertebral canal remains smooth during bendings of the column and they aid in the return of the vertebrae to the resting position. They begin between the second and third cervical vertebrae and extend to the last lumbar. They show a distinct groove in the middle line. Their number is 23 pairs.

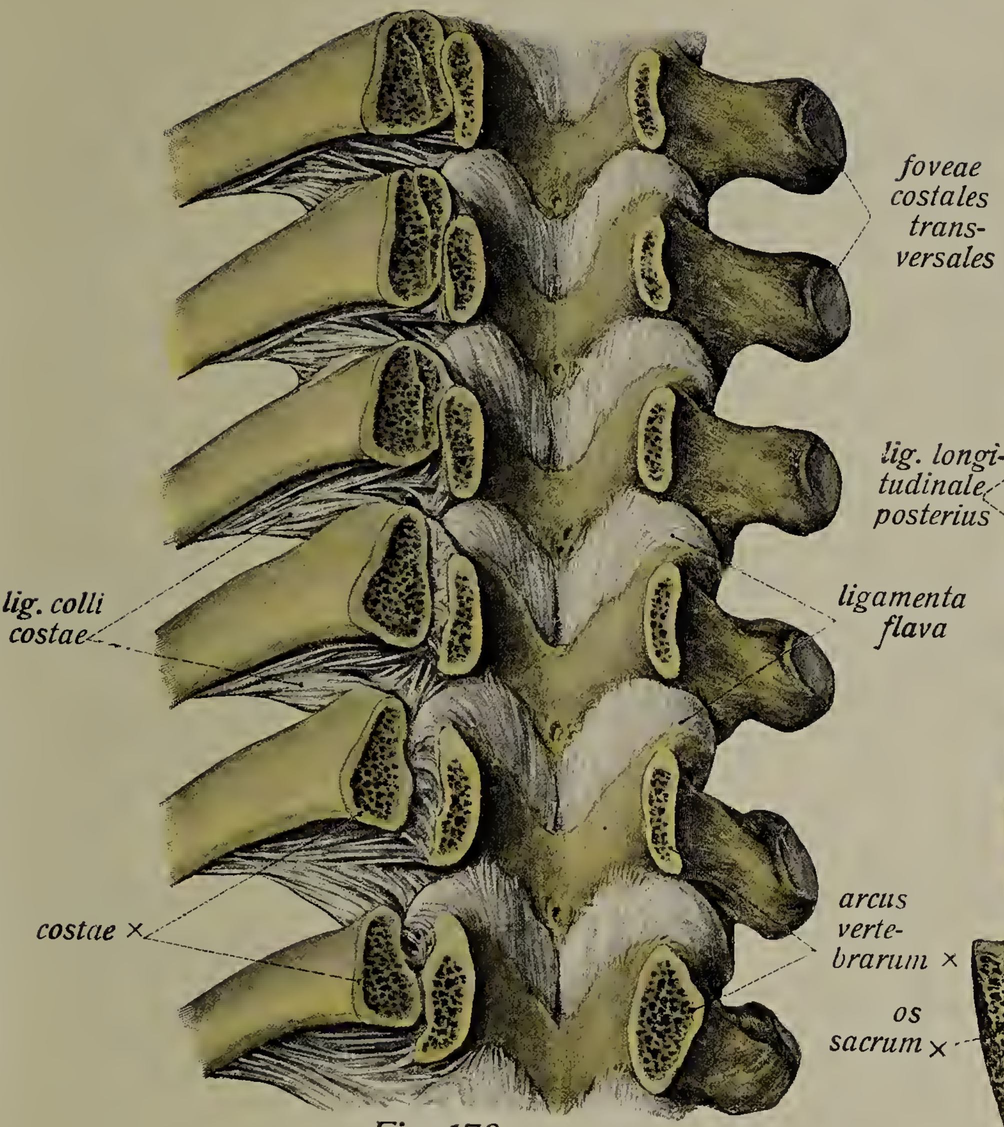


Fig. 179.

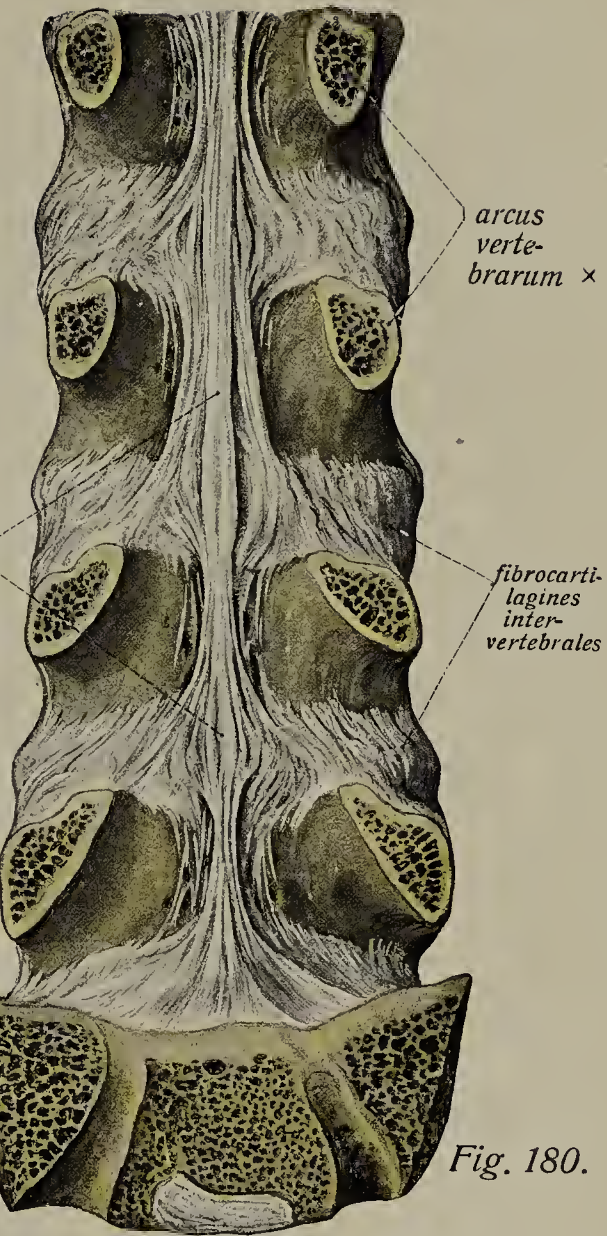

arcus vertebrarum ×
lig. longitudinale posterius
fibrocartilagines intervertebrales
os sacrum ×

Fig. 180.

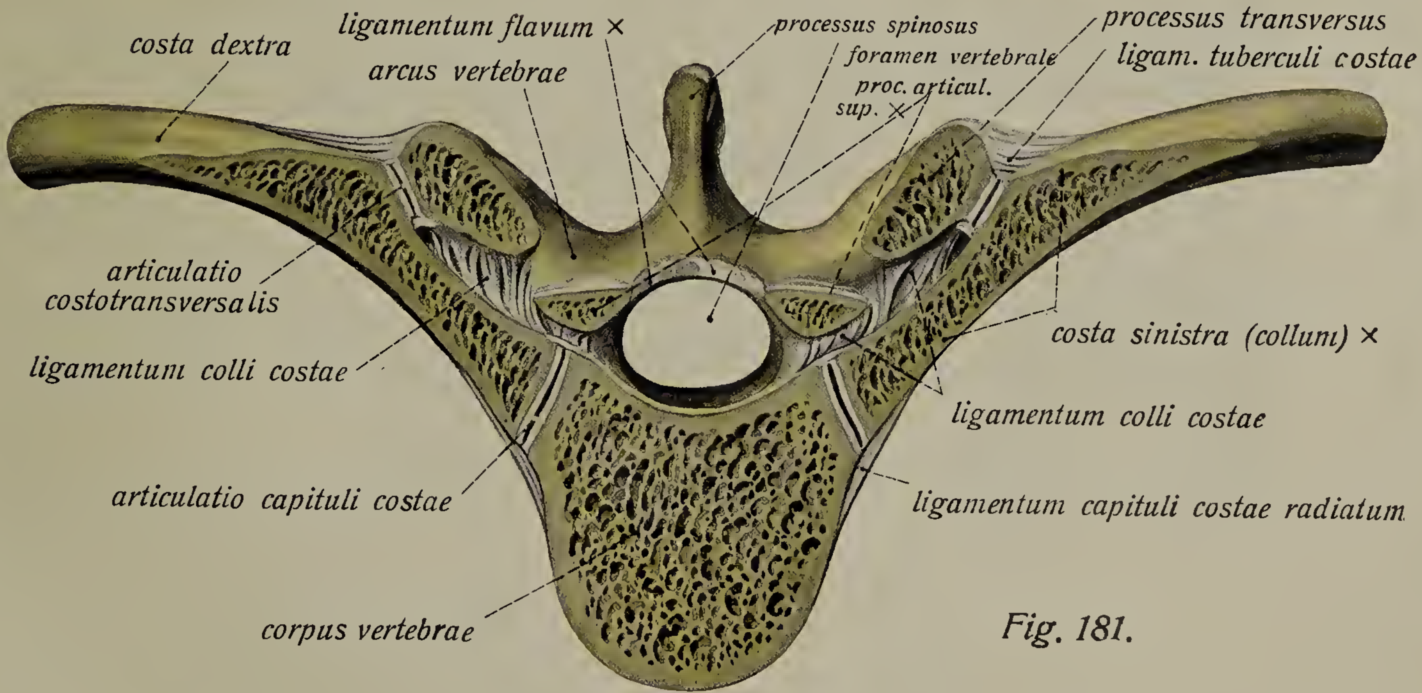


Fig. 181.

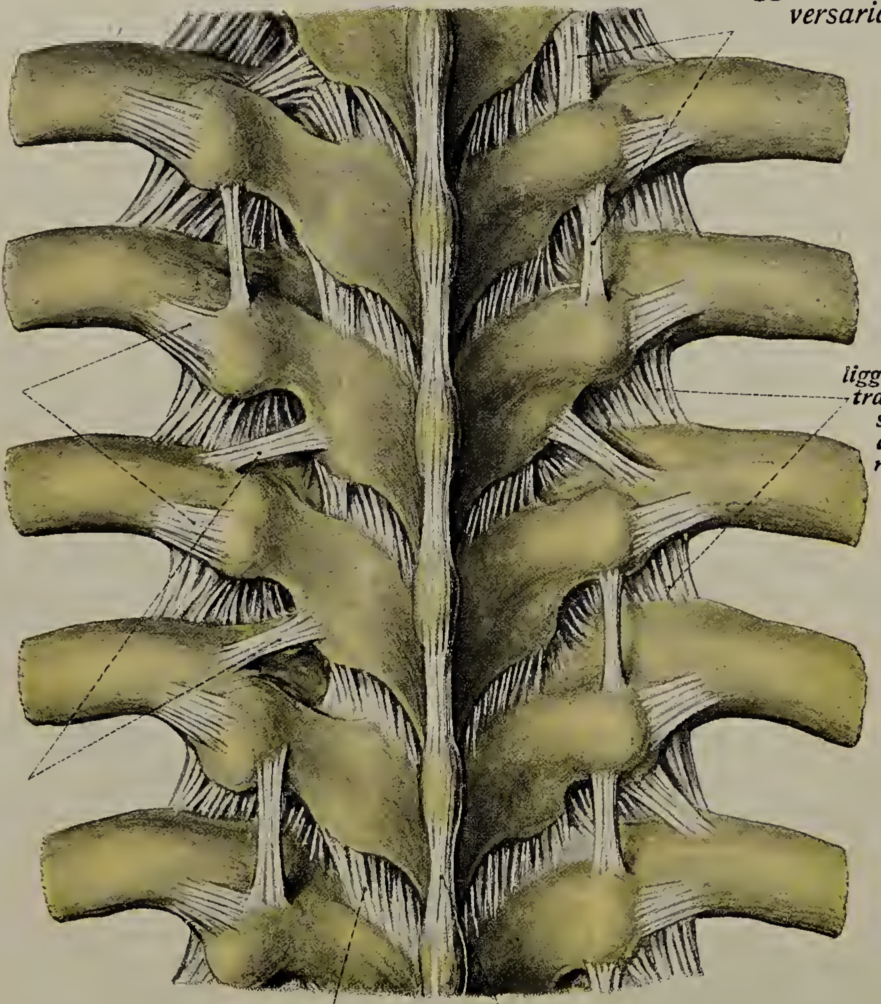

ligg. intertransversaria
ligamenta tuberculorum costarum
ligg. costotransversaria anteriora
ligg. costotransversaria posteriora
lig. flavum
ligamentum supraspinale

Fig. 182.

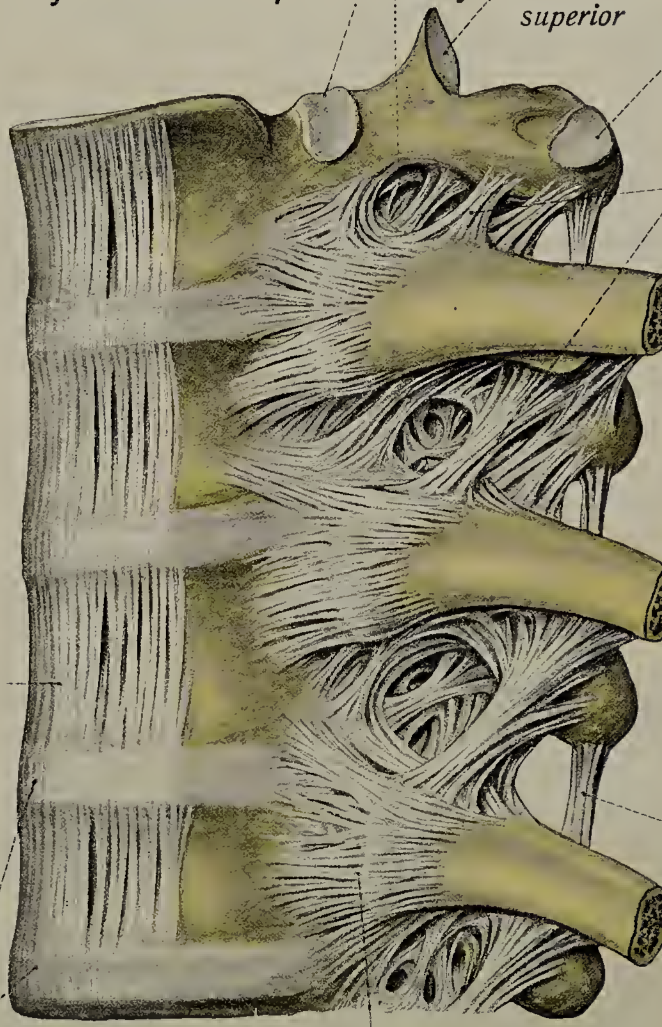

foramen costotransversarium
fovea costalis superior
facies articularis superior
fovea costalis transversalis
ligamenta costotransversaria anteriora
costae ×
lig. longitudinale anterius
lig. intertransversarium
fibrocartilagines intervertebrales
ligamentum capituli costae radiatum

Fig. 183.

The Costo-vertebral Joints and Ligaments. (Cont.)

Fig. 182. The ligaments of the middle and lower thoracic vertebrae and ribs from behind. ($^{3}/_{4}$)

Fig. 183. The ligaments of the middle and lower thoracic vertebrae and ribs from the left side. ($^{3}/_{4}$)
The uppermost rib has been disarticulated.

The *intertransverse ligaments,* extending between the transverse processes of adjoining vertebrae, are unimportant. They are constant only in the thoracic region. The spinous processes of successive vertebrae are united by *interspinous ligaments,* which are most strongly developed in the lumbar region. They are united on one edge with the ligamenta flava and on the other with the *supraspinous ligament.* This unites the tips of the various spinous processes and also runs over the tips as a continuous ligament. The interspinal and supraspinal ligaments occur through the entire extent of the true vertebrae and extend somewhat upon the sacrum also.

The ribs unite posteriorly with the thoracic vertebrae in a joint; anteriorly they unite in a joint or a synchondrosis with the sternum or with one another. Only the last two ribs fail to unite with skeletal parts at their anterior ends. In the *costo-vertebral articulations* the head of a rib articulates with two adjoining vertebrae and the tubercle with a transverse process, except that this latter connection is wanting in the last two ribs, which articulate with only one vertebral body. The capitular articulations with the exception of the first and the two last, are characterized by the fact that the intervertebral fibro-cartilage between the two vertebrae which form the socket is attached to the head of the rib, forming the *interarticular ligament* and dividing the joint into two portions. The *radiate ligaments,* which radiate from the head of the rib upon the lateral surfaces of the articulating vertebrae, strengthen the weak articular capsules.

The *costo-transverse articulations* possess a loose capsule and are characterized by possessing a whole series of accessory ligaments. As a reinforcing band for the posterior surface of the capsule there is a quadrangular, short, tense *tubercular ligament,* which completely fills the space between the neck of the rib and the transverse process. The *anterior* and *posterior costo-transverse ligaments* pass between the necks of the ribs and the transverse processes. The posterior are much weaker than the anterior and are attached to the articular processes of the vertebrae as well as to their transverse processes. The body of the vertebra together with the anterior ligament bounds a *costo-transverse foramen,* through which the anterior (intercostal) ramus of the spinal nerve makes its exit.

The Sterno-costal Articulations and those between the Atlas, Axis and Skull.

The cartilages of the true ribs unite with the sternum by the *sterno-costal articulations.* The first cartilage, however, is always united to the manubrium by a synchondrosis. In the articulation of the second cartilage there is always a band passing to the end of the cartilage from the *sternal synchondrosis;* it is the *interarticular ligament* and it makes the joint two-chambered. In the sternal articulations of the third to the seventh rib the interarticular ligament is inconstant and frequently, when it is present, it divides the joint cavity unequally. Reinforcing the anterior surface of the joints are the *radial ligaments,* which radiate out fanlike from the end of the cartilage upon the anterior surface of the sternum (see Fig. 195). Those of the lower ribs form by the interlacing of their fibres on the lower part of the sternum the *sternal membrane.* Between the cartilages of the seventh to the tenth ribs *interchondral articulations* may occur. Sometimes the sternal synchondrosis between the manubrium and the body of the sternum has a joint cavity.

The Atlanto-occipital and Atlanto-axial (Atlanto-epistrophic) articulations.

For the movement of the head upon the vertebral column there is a combination of joints, including the *atlanto-occipital articulations* and the *atlanto-axial (atlanto-epistrophic).* Peculiar to the union of the first two cervical vertebrae with the occipital bone are the *atlanto-occipital membranes,* which serve to close the wide intervals between the atlas and the occipital and between the atlas and axis *(epistropheus).* The anterior membrane extends between the occipital and the anterior arch of the atlas, the posterior one, a continuation of the ligamenta flava, closes principally the gap between the occipital and the posterior arch of the atlas, but also extends between the posterior arch of the atlas and the arch of the axis (epistropheus).

The *atlanto-occipital articulations* act as a symmetrical double joint. They are formed by the union of the occipital condyles with the superior articular surfaces of the atlas and according to the form of the articulating surfaces are ellipsoid joints. The articular capsule is rather broad and loose and lacks reinforcing ligaments.

Fig. 184. The sternum and costal cartilages divided in the frontal plane. $(^{3}/_{4})$

Fig. 185. A portion of the occipital bone the atlas and axis (epistropheus) and their ligaments from behind. $(^{9}/_{10})$
On the left side the articular capsule is removed.

Fig. 186. A portion of the occipital bone and the upper three vertebrae from in front. $(^{9}/_{10})$
The capsular ligaments are removed on the right side.

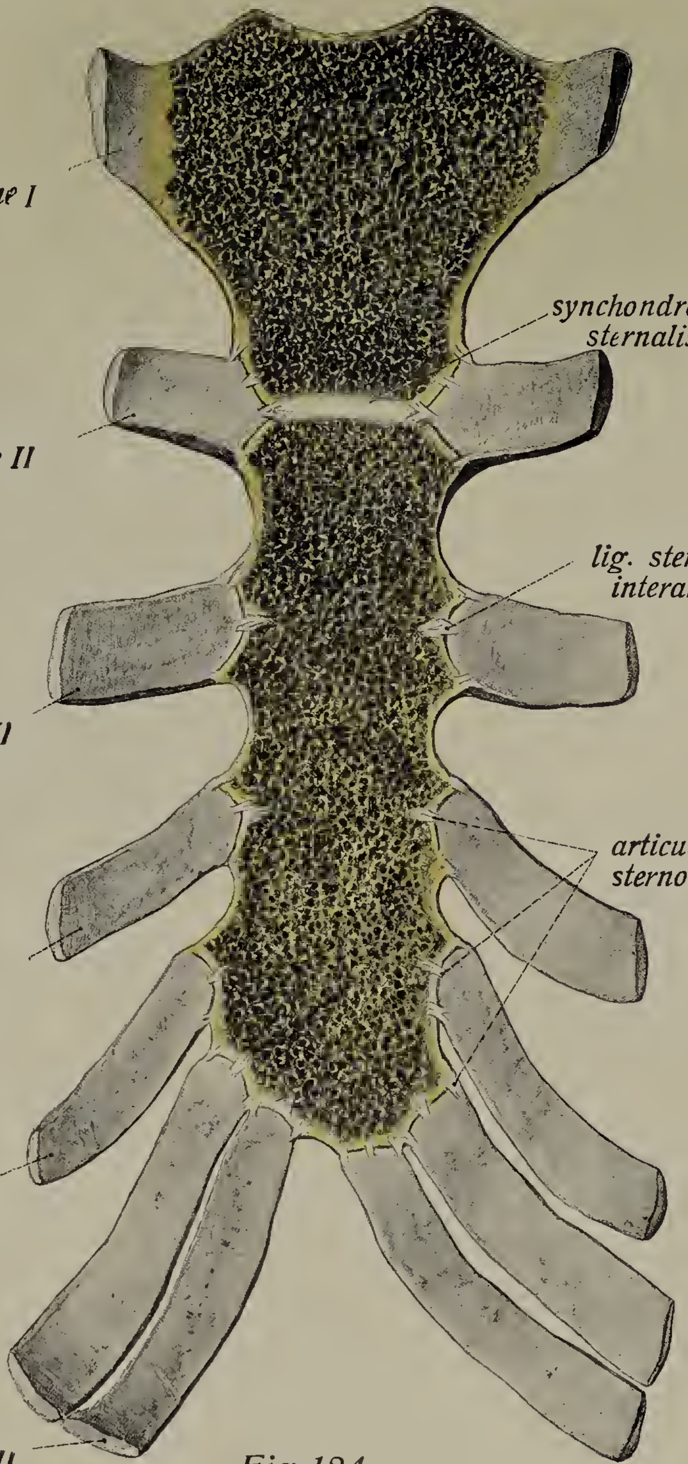


Fig. 184.

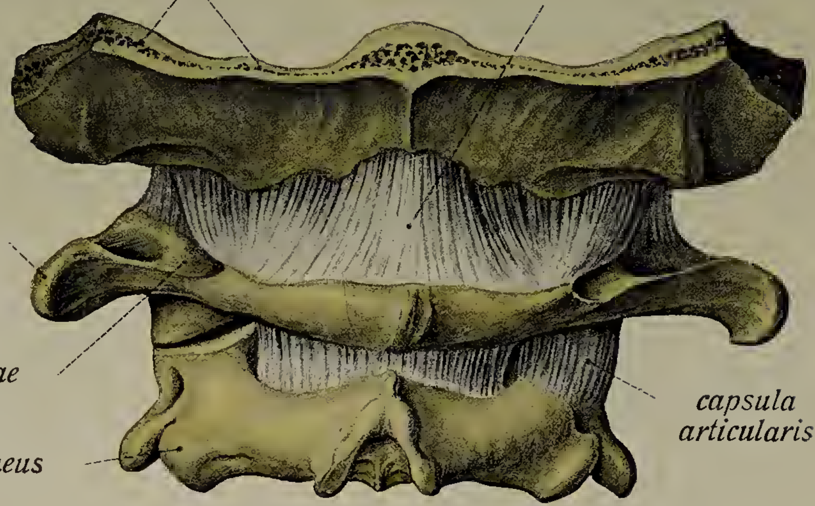

os occipitale
membrana atlanto-occipitalis posterior
processus transversus atlantis
sulcus arteriae vertebralis
capsula articularis
epistropheus

Fig. 185.

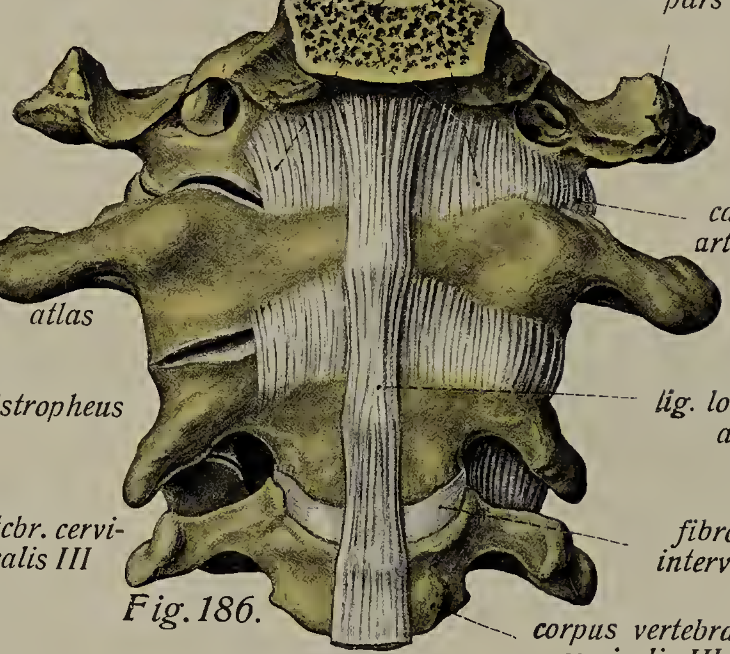

pars basilaris ossis occipitalis
membrana atlanto-occipitalis anterior
pars lateralis ossis occipitalis
capsula articularis
atlas
epistropheus
lig. longitudinale anterius
vertcbr. cervicalis III
fibrocartilago intervertebralis I
corpus vertebrae cervicalis III

Fig. 186.

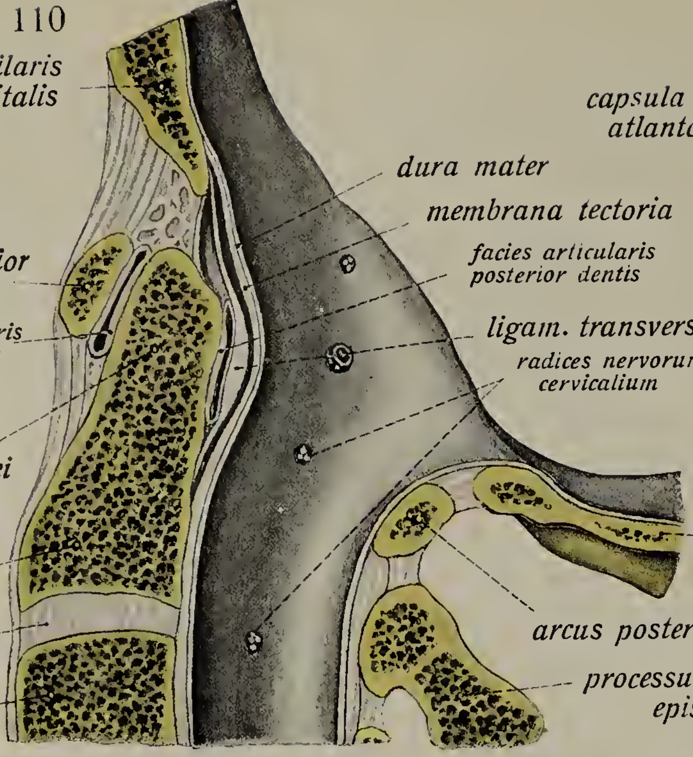

pars basilaris ossis occipitalis
dura mater
membrana tectoria
arcus anterior atlantis
facies articularis posterior dentis
facies articularis anter. dentis
ligam. transversum
radices nervorum cervicalium
dens epistrophei
squama occipitalis
corpus epistrophei
arcus posterior atlantis
fibrocartilago intervertebr. I
corpus vertebrae cervicalis III
processus spinosus epistrophei

Fig. 187.

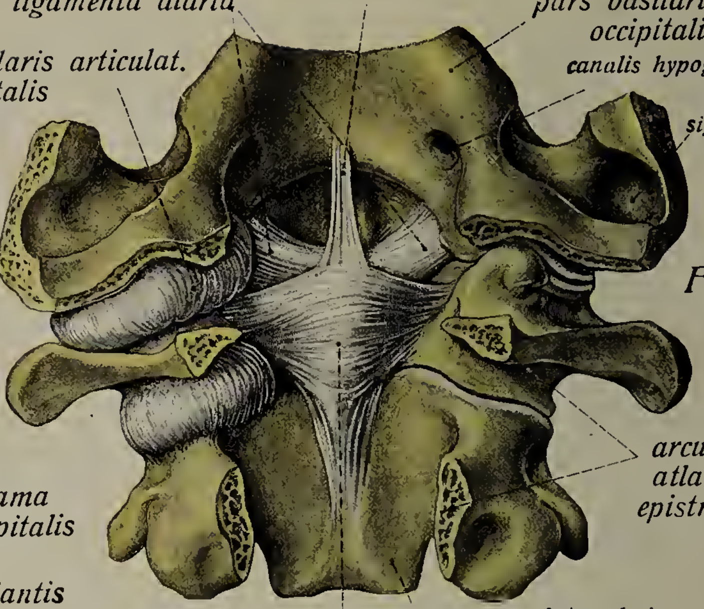

ligam. cruciatum (crus super.)
ligamenta alaria
pars basilaris ossis occipitalis
capsula articularis articulat. atlantooccipitalis
canalis hypoglossi
sulcus sigmoideus
arcus post. atlantis et epistrophei ×
corpus epistrophei
ligamentum cruciatum

Fig. 188.

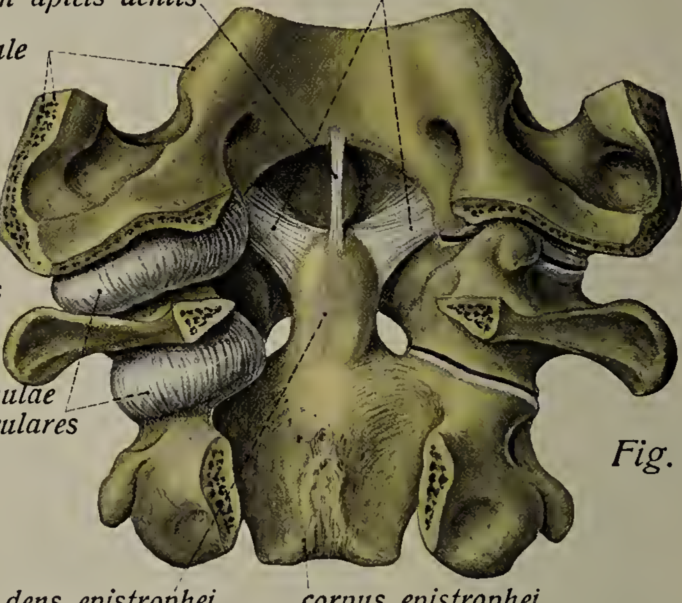


Fig. 189.

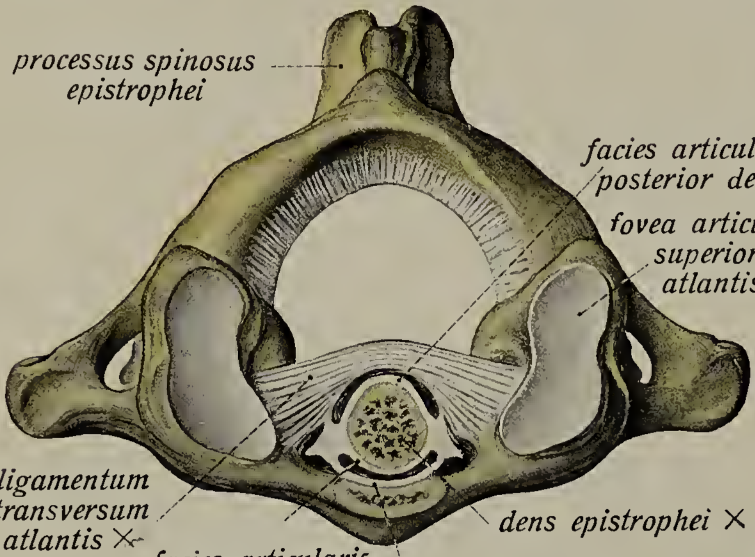

processus spinosus epistrophei
facies articularis posterior dentis
fovea articularis superior atlantis
ligamentum transversum atlantis ×
dens epistrophei ×
facies articularis anterior dentis
fovea dentis

Fig. 190.

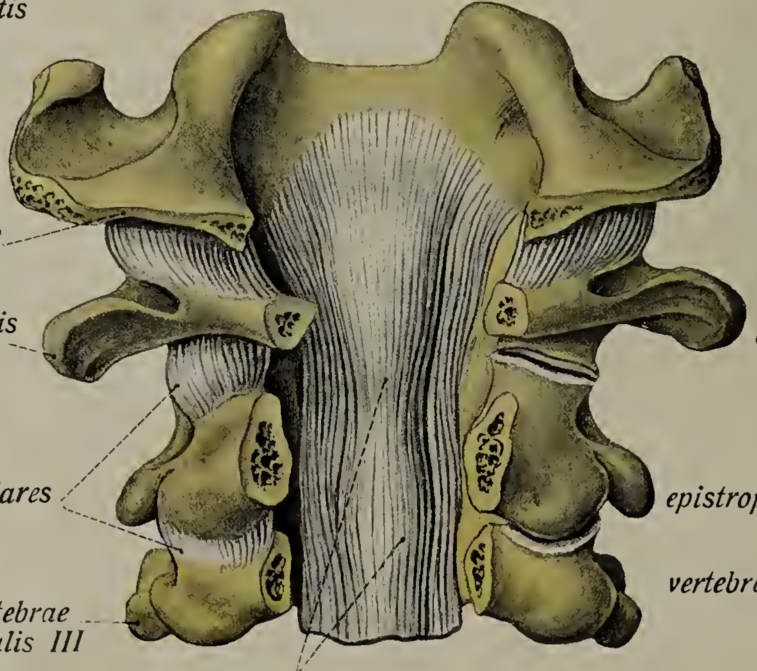

os occipitale
os occipitale
atlas
processus transversus atlantis
capsulae articulares
epistropheus
vertebra cervicalis tertia
processus transversus vertebrae cervicalis III
membrana tectoria

Fig. 191.

The Atlanto-occipital and Atlanto-axial (Atlanto-epistrophic) Articulations. (Cont.)

Fig. 187. Median longitudinal section through the atlantoaxial articulation, somewhat schematized. ($^1/_1$)

Fig. 188. The cruciate ligament after removal of the tectorial membrane. The posterior part of the occipital and the arches of the three upper cervical vertebrae have been cut away and, on the right side, the articular capsules have been removed. ($^9/_{10}$)

Fig. 189. The alar ligaments after removing the cruciate ligament. The preparation otherwise the same as in Fig. 188. ($^9/_{10}$)

Fig. 190. The articulation of the dens of the axis (epistropheus) with the atlas. The atlas has been disarticulated at the atlanto-occipital joints, the dens and anterior arch of the atlas have been cut horizontally. ($^9/_{10}$)

Fig. 191. The tectorial membrane from behind. The preparation as in Fig. 188. ($^9/_{10}$)

The atlanto-axial (atlanto-epistrophic) articulation is formed by three separate joints: 1. The paired joints between the lower articular surfaces of the atlas and the upper of the axis (epistropheus); these show no special peculiarities except that the articular surfaces are usually greatly incongruent; 2. the joint between the dens of the axis (epistropheus) and the anterior arch of the atlas; and 3. that between the posterior surface of the dens and the transverse ligament. This third joint is a rotary joint with incompletely formed articular surfaces, since the dens is covered by cartilage only on its anterior and posterior surfaces.

The capsules of the atlanto-axial joint are wide and loose and are reinforced by a series of accessory ligaments. The very strong and firm *transverse ligament* arises from the medial borders of the lateral masses of the atlas and traverses its vertebral foramen, enclosing the dens from behind. It is cartilaginous where it passes over the dens and articulates with that process. From the middle of the ligament there is an upper and a lower prolongation. The upper one passes to the occipital bone, the lower inserts into the posterior surface of the body of the axis (epistropheus). The cruciform ligament so formed is termed the *cruciate ligament.* Three other ligaments belonging to the articulation are attached to the dens, a weak middle one and two strong lateral. The middle one, the *apical ligament* of the dens, is an unimportant thin band passing from the apex of the dens to the margin of the foramen magnum. The lateral ligaments, the *alar ligaments,* are much stronger and pass obliquely upward from the dens to the medial border of the occipital condyles, uniting the axis (epistropheus) directly with the skull. The ligaments of the joints are covered, towards the vertebral canal, by a broad firm sheet of fibres, the *membrana tectoria*, which is continuous with the dura mater at the foramen magnum and with the posterior longitudinal ligament below.

The Ligaments of the Skull and the Mandibular Articulation.

Fig. 192. The right mandibular articulation, lateral side. ($^1/_1$)
Fig. 193. The right mandibular articulation, medial side. ($^1/_1$)
Fig. 194. The right mandibular articulation opened by a sagittal section. The zygomatic bone is cut through in front. ($^1/_1$)

The *mandibular articulation* is between the capitulum of the mandible and the mandibular fossa and articular tubercle of the temporal bone. The joint cavity is completely divided into two parts by an *articular disk,* whose circumference is united with the *articular capsule.* The capsule is rather loose and thin. It surrounds the mandibular fossa (except the non-cartilaginous portion), the articular tubercle and the head of the mandible, having its insertion on the neck. It is reinforced by a *temporo-mandibular ligament*, which passes from the zygomatic bone to the neck of the mandible.

The Independent Ligaments in the Head.

Near the mandibular articulation, but without any direct connection with it, are the *spheno-mandibular* and *stylo-mandibular ligaments*. The former arises from the under surface of the great wing of the sphenoid near the angular spine and inserts into the lingua of the mandible. The latter arises from the styloid process and goes to the angle of the mandible. Both ligaments are weak and somewhat fascia-like, the stylomandibular spreading out directly into the fascia of the internal pterygoid muscle (bucco-pharyngeal fascia).

Besides these there are two other independent ligaments in the head. The *pterygo-spinous ligament* runs between the angular spine of the sphenoid and the upper end of the lateral plate of the pterygoid process. Sometimes it ossifies and then forms the *pterygo-spinous process* (Civinini). The *stylo-hyoid ligament* runs from the styloid process of the temporal to the lesser cornu of the hyoid. It frequently contains pieces of cartilage or bone, remains of the middle portion of the second branchial or hyoid arch from which the lesser cornu of the hyoid and the styloid process are formed. Several clefts between the bones of the skull are also completely or partly closed by ligamentous masses as, for instance, the two orbital fissures, the spheno-petrous and petro-occipital fissures, except where these give passage to nerves and vessels.

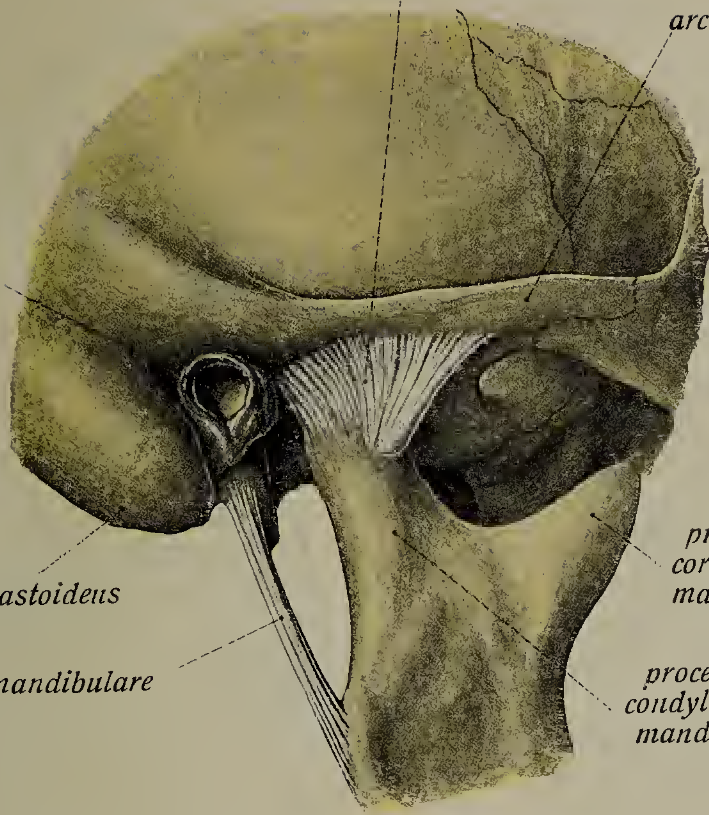

lig. temporomandibulare
arcus zygomaticus
meatus acusticus externus
proc. mastoideus
lig. stylomandibulare
processus coronoideus mandibulae
processus condyloideus mandibulae

Fig. 192.

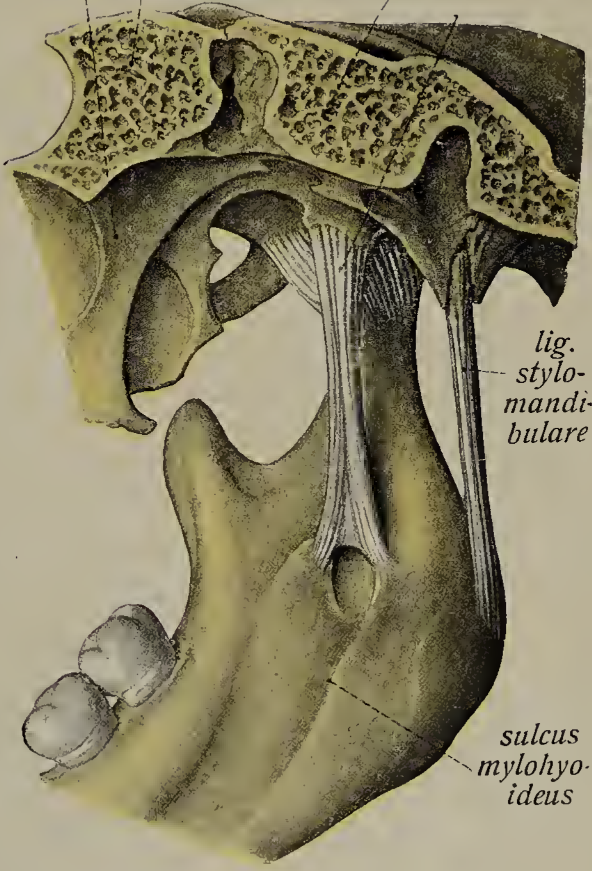


Fig. 193.

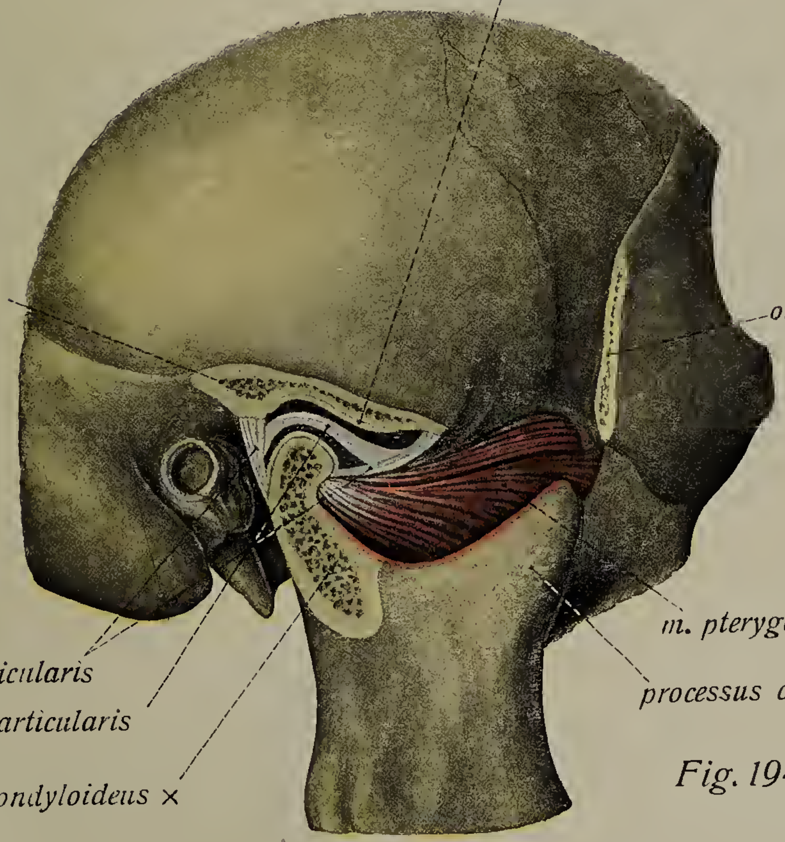


Fig. 194.

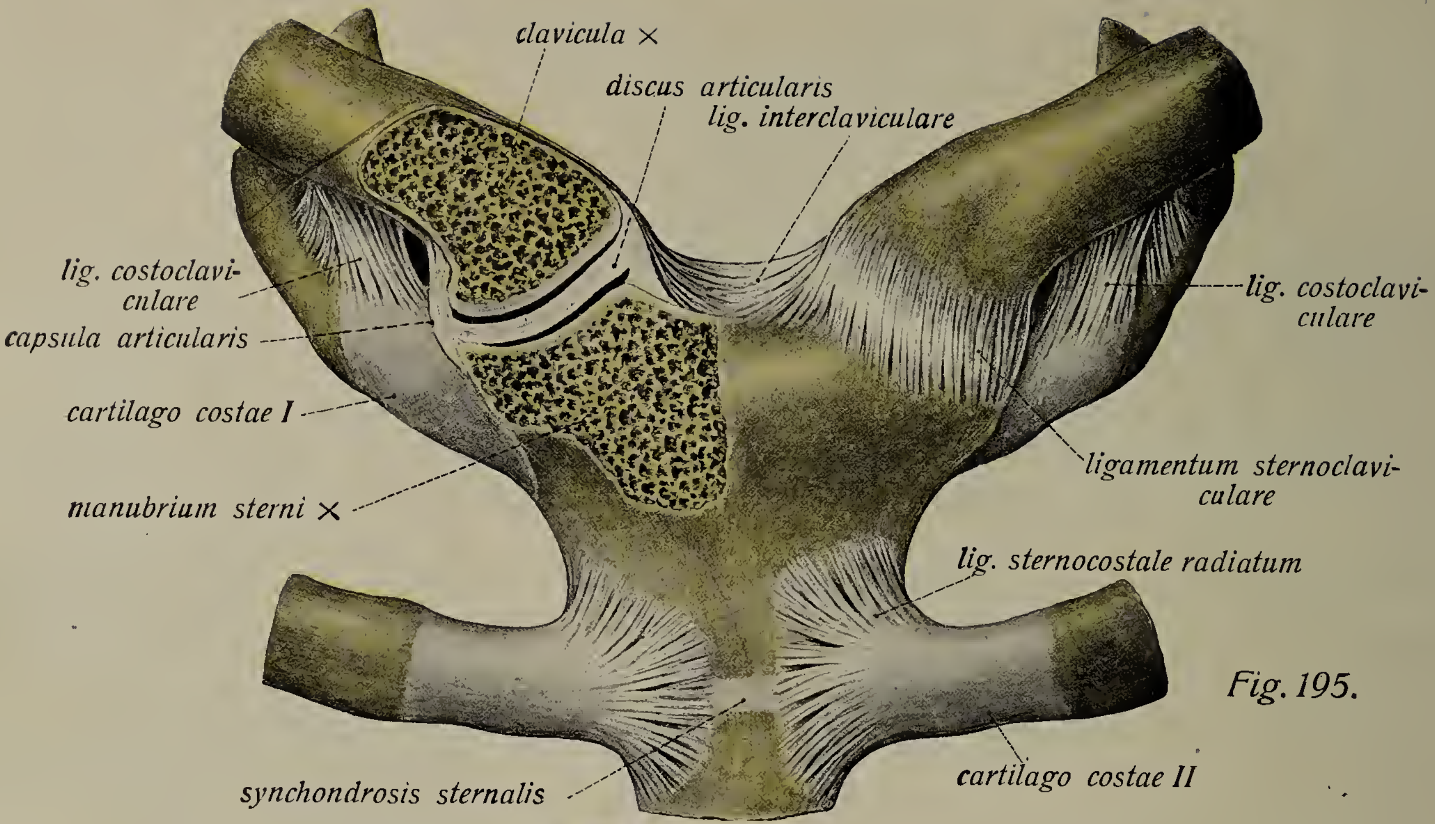


Fig. 195.

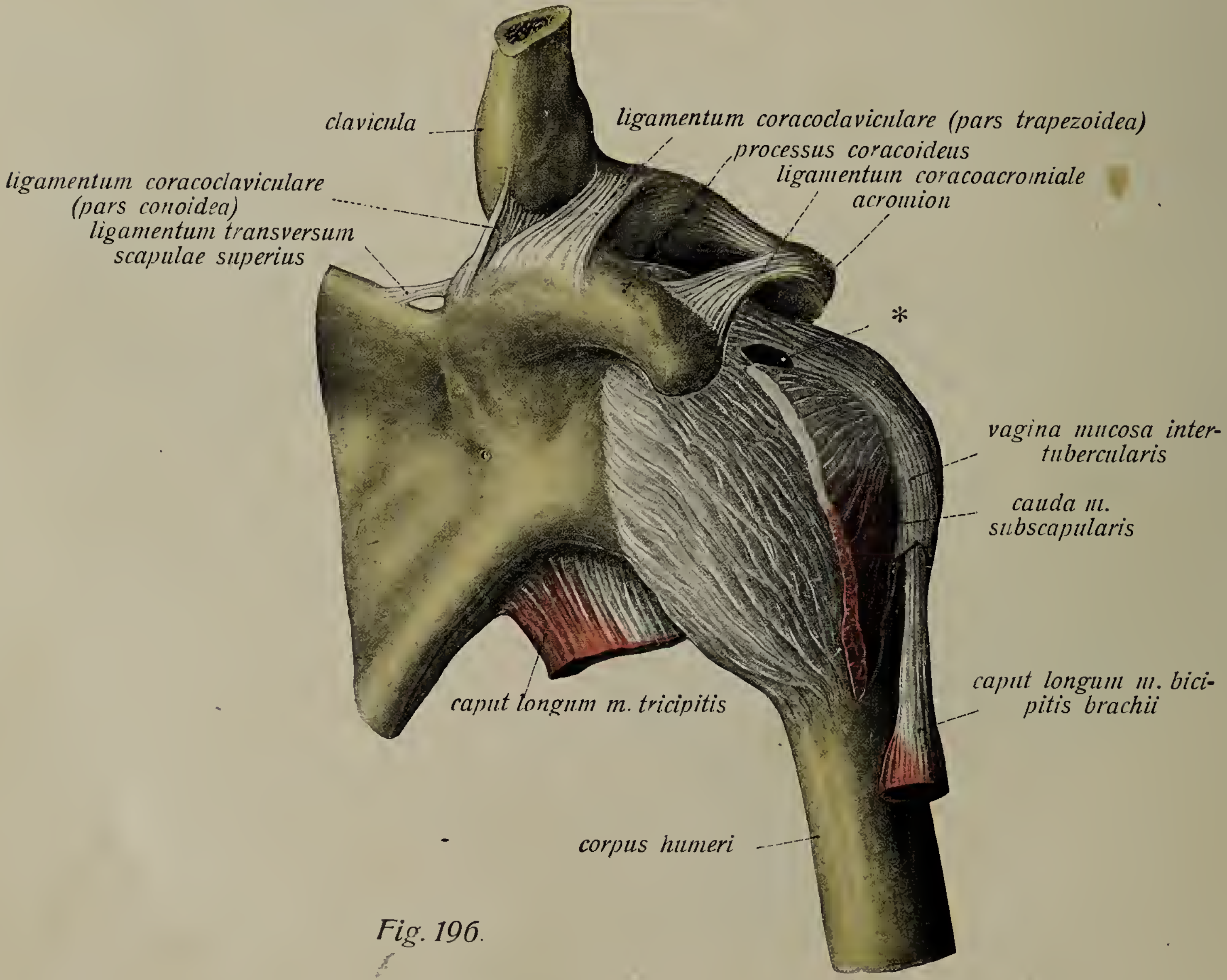

clavicula
ligamentum coracoclaviculare (pars trapezoidea)
processus coracoideus
ligamentum coracoacromiale
acromion
ligamentum coracoclaviculare (pars conoidea)
ligamentum transversum scapulae superius
*
vagina mucosa intertubercularis
cauda m. subscapularis
caput longum m. tricipitis
caput longum m. bicipitis brachii
corpus humeri

Fig. 196.

The Joints and Ligaments of the Upper Extremity.

The Sterno-Clavicular and Acromio-clavicular Articulations.

Fig. 195. The two sterno-clavicular joints and the union of the cartilage of the upper rib with the sternum, from in front. The right sterno-clavicular joints is opened by a frontal section. ($^4/_5$)

Fig. 196. The left shoulder and acromio-clavicular joints from in front and medial. ($^3/_4$) * = communication of the subscapular bursa (not retained) with the joint cavity. Above it the coraco-humeral ligament.

The *sterno-clavicular articulation* is between the clavicular notch on the manubrium of the sternum and the sternal articular surface of the clavicle. The two articular surfaces are made congruent by the interposition of an *articular disk,* which divides the joint cavity into two portions. The loose and thin *articular capsule* is strengthened over its entire surface by strong reinforcing ligaments. The *sterno-clavicular ligament* is fused with the anterior surface of the capsule and the *interclavicular ligament* unites the sternal ends of the two clavicles, extending across the jugular notch and resting on the upper border of the manubrium; it thus strengthens the upper surface of both sterno-clavicular joints. The *costo-clavicular ligament* is only functionally a part of the sterno-clavicular articulation. It is an independent, exceedingly strong ligament, passing between the cartilage of the first rib and the costal tubercle of the clavicle, and almost filling the interval between the sternal end of the clavicle and the first rib. Its rather short fibres are put on the stretch by a relatively slight abduction of the clavicle from the thorax.

The *acromio-clavicular articulation* is between the acromial articular surface of the clavicle and the articular surface of the acromion. Also in this joint there is a weak *articular disk,* which is frequently incomplete and may be entirely wanting. The *articular capsule* is strengthened over its upper, stronger portion by the acromio-clavicular ligament which unites the ends of the adjoining bones. A very strong *coraco-clavicular ligament* unites the acromial end of the clavicle with the scapula, arising from the upper surface of the base of the coracoid process and passing to the coracoid tuberosity of the clavicle. It consists of two portions, an anterior flat, quadrangular *trapezoid ligament* and a posterior, triangular *conoid ligament,* small below and broad above (see Fig. 199).

The Ligaments of the Shoulder Girdle and the Shoulder Joint *(articulatio humeri).*

Fig. 197. The left shoulder joint with stumps of the supraspinatus, infraspinatus, teres minor and long head of the triceps, from behind. ($^3/_4$)

Fig. 198. The left shoulder joint with stumps of the same muscles, from behind and above. The acronion has been cut away. ($^3/_4$)

On the scapula there are three independent ligaments: 1. the *coraco-acromial;* 2. the *superior transverse;* and 3. the *inferior transverse.*

The *coraco-acromial ligament* is a strong, dense but flat band uniting the anterior border of the acromion process with the posterior border of the coracoid process. It lies directly above the shoulder joint.

The *superior transverse ligament* is a short, firm band that bridges over the scapular notch, converting it into a foramen. Occasionally the ligament is replaced by bone.

The *inferior transverse ligament* is much weaker than the superior, consisting of only quite delicate fibre bundles, which lie below the root of the acromion, where the supraspinous and infraspinous fossae communicate. It is closely interwoven with the fascia of the infraspinatus muscle.

The Shoulder Joint *(articulatio humeri).*

The shoulder joint is between the glenoid cavity of the scapula and the head of the humerus. The glenoid cavity is relatively small and only slightly concave, but it is materially enlarged and deepened by a strong, fibrous *glenoidal lip*, which sorrounds the whole border of the bony socket. Nevertheless the socket of the joint is decidedly smaller than the articulating head, and free movement, accordingly, is not hindered by the socket, the joint being the most freely moveable joint in the body.

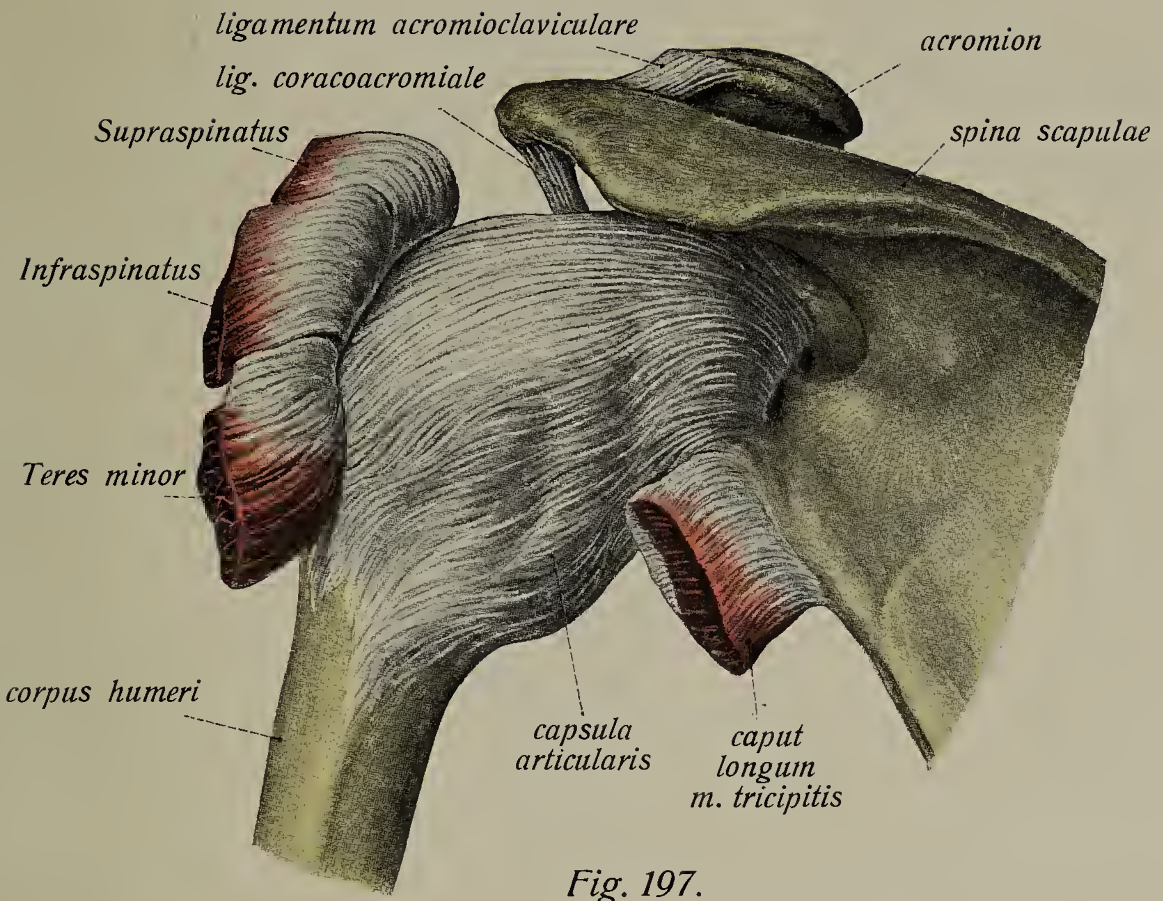


Fig. 197.

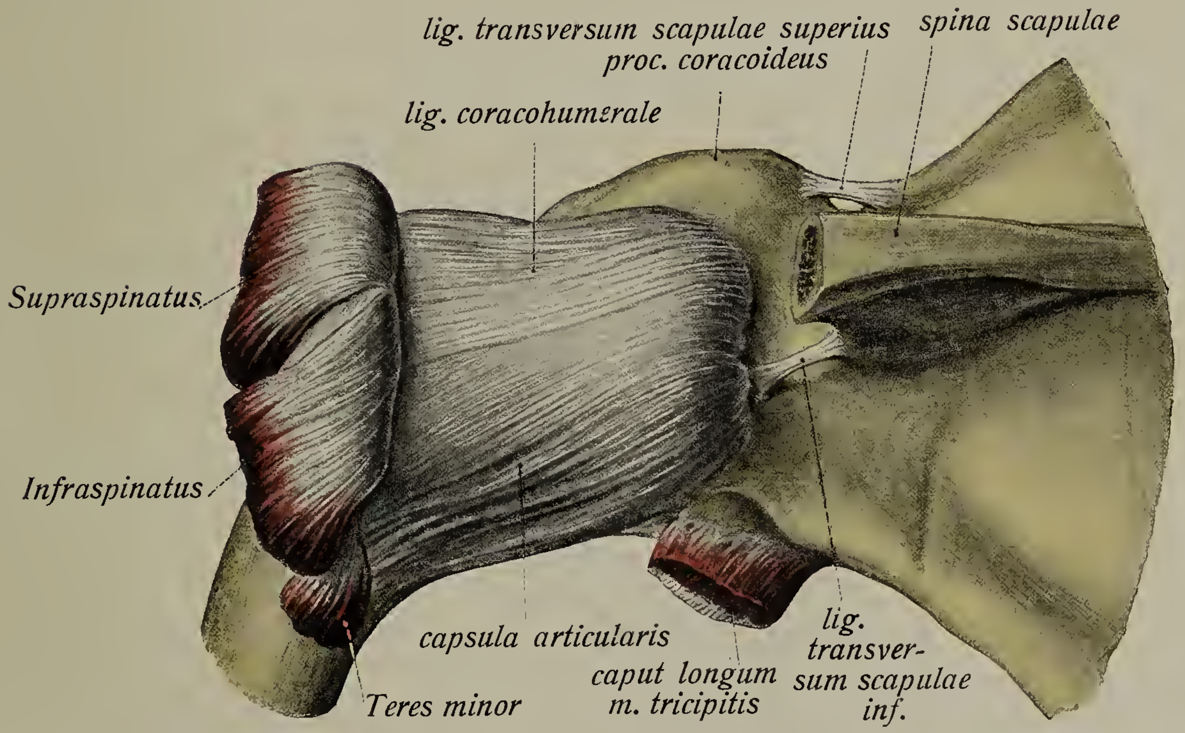


Fig. 198.

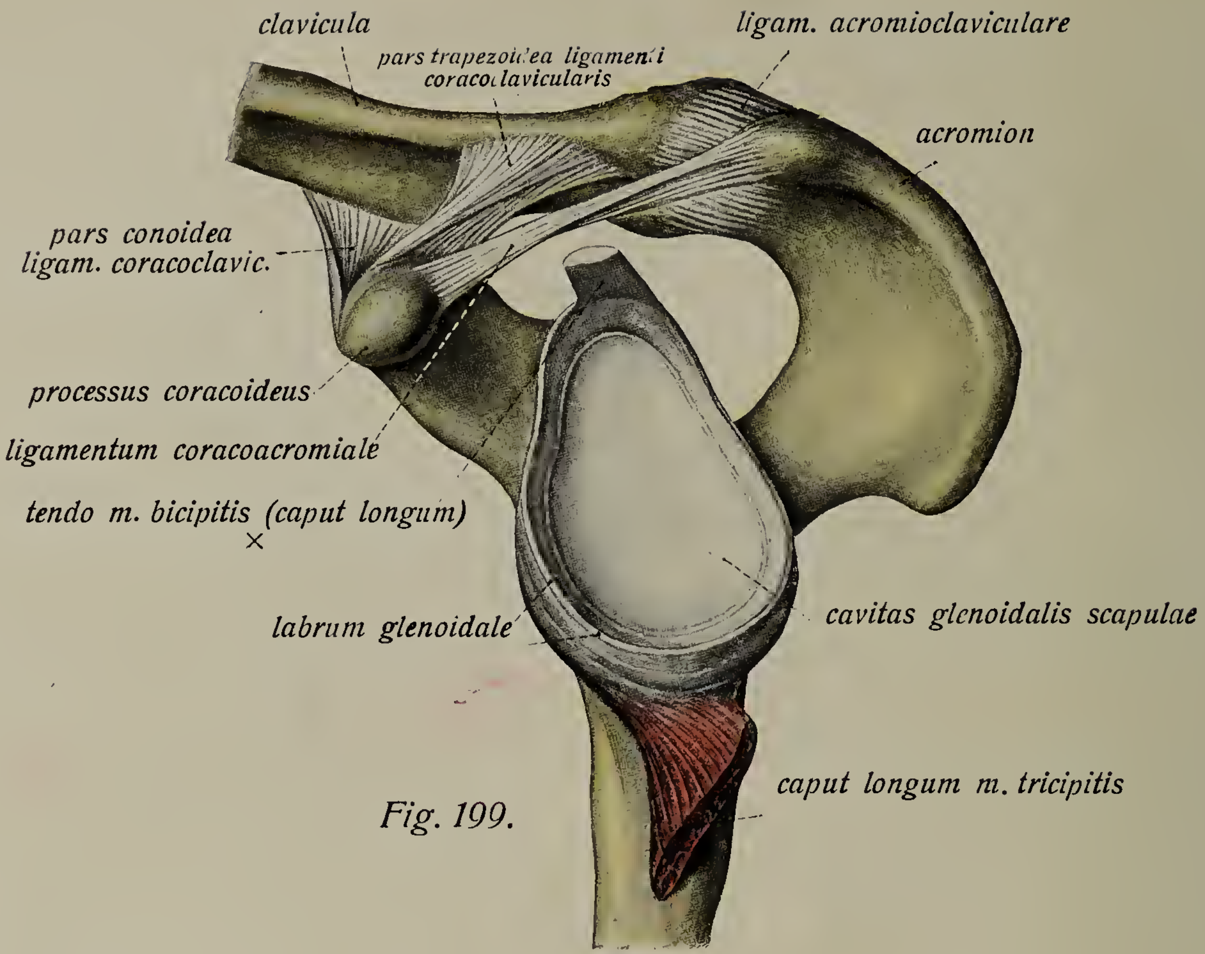

clavicula
pars trapezoidea ligamenti coracoclavicularis
ligam. acromioclaviculare
acromion
pars conoidea ligam. coracoclavic.
processus coracoideus
ligamentum coracoacromiale
tendo m. bicipitis (caput longum)
×
labrum glenoidale
cavitas glenoidalis scapulae
caput longum m. tricipitis

Fig. 199.

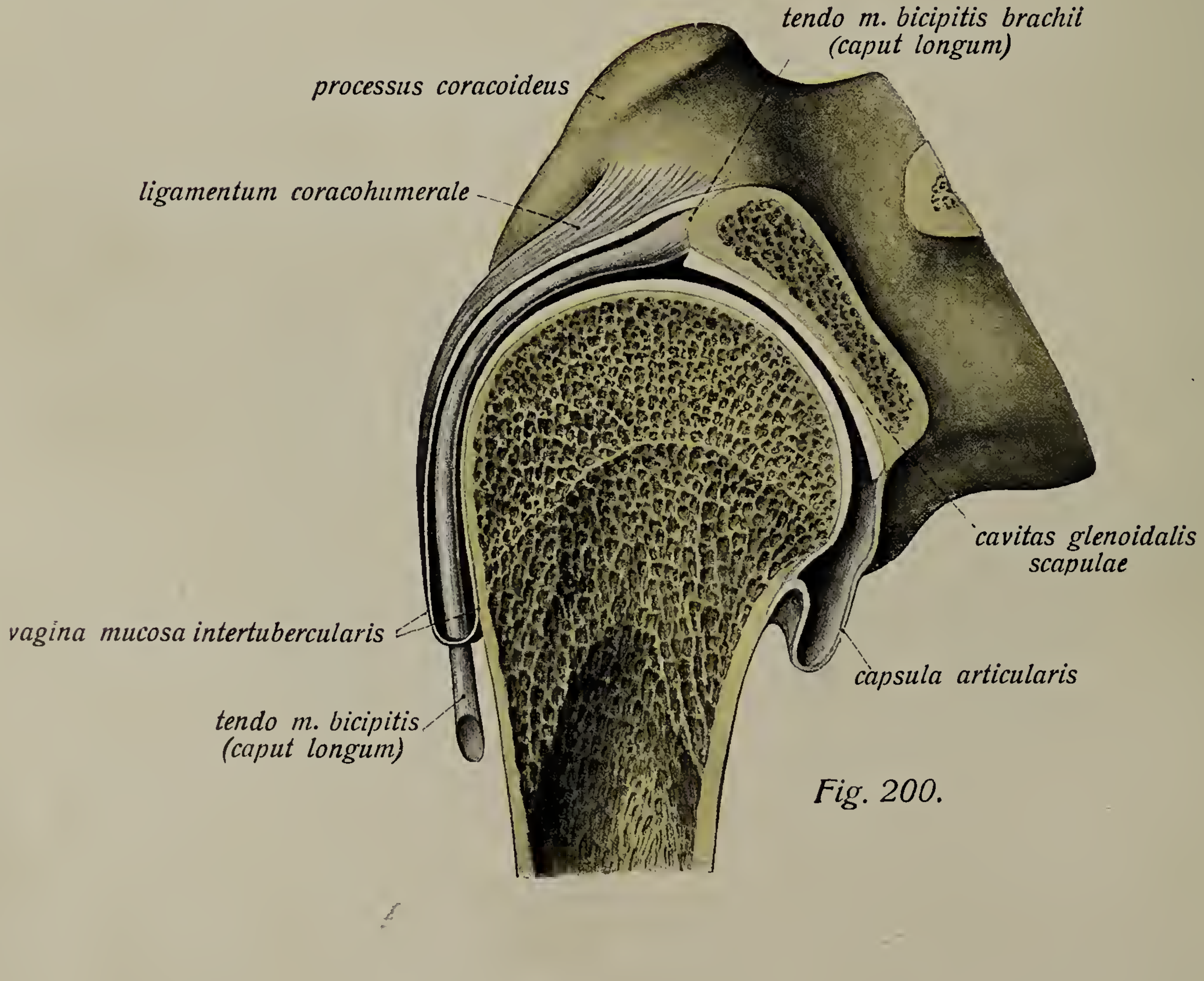

tendo m. bicipitis brachii (caput longum)
processus coracoideus
ligamentum coracohumerale
cavitas glenoidalis scapulae
vagina mucosa intertubercularis
capsula articularis
tendo m. bicipitis (caput longum)

Fig. 200.

The Shoulder Joint *(articulation humeri).* (Cont.)

Fig. 199. The socket of the left shoulder joint after cutting through the capsule and the tendon of the biceps. (3/4)

Fig. 200. Frontal longitudinal section of the left shoulder joint and the intertubercular sheath, parallel with the tendon of the biceps. (3/4)

The *articular capsule* of the shoulder joint is wide and loose, as is necessary in a joint with free movement. Although it is on the whole thin, it receives strong reinforcements from the tendons of the muscles that pass over it (supraspinatus, infraspinatus, teres minor, subscapularis) and from a strong reinforcing band, the *coraco-humeral ligament.* The articular capsule arises from the border of the glenoidal lip and inserts on the anatomical neck of the humerus. The *coracohumeral ligament* arises at the root of the coracoid process and is at first independent, but later becomes completely fused with the capsule and passes to an insertion in the neighborhood of the two tubercles on the anatomical neck of the humerus.

A peculiarity of the shoulder joint is that it is traversed throughout its entire length by a tendon, that of the long head of the biceps. The tendon arises at the supraglenoid tubercle, where it is fused with the upper part of the glenoidal lip, and runs through the cavity of the joint beneath the coraco-humeral ligament, and then along the intertubercular groove, being enclosed in this portion of its course by a prolongation of the capsule, *the intertubercular sheath.* The intertubercular groove is lined with cartilage throughout the extent of the sheath. Furthermore a thin-walled *subscapular bursa,* lying beneath the tendon of the subscapular muscle, also communicates with the joint cavity. This bursa is situated below the concave anterior surface of the coracoid process, between the coraco-humeral ligament and a slight-thickening of the medial surface of the capsule.

The Elbow Joint *(articulato cubiti).*

Fig. 201. Left elbow joint from in front. ($^2/_3$)
Fig. 202. Left elbow joint from the dorsal and radial side. ($^2/_3$)
Fig. 203. The two bones of the left forearm with the interosseous membrane; the elbow joint opened; the anular ligament is divided. ($^2/_3$)

The elbow joint is a typical *composite articulation*, being composed, firstly, of the articulation of the trochlea of the humerus with the semilunar notch of the ulna, the *humero-ulnar articulation;* secondly, of that of the capitulum of the humerus with the capitular bone of the radius, the *humero-radial articulation;* and, thirdly, of that of the radial notch of the ulna with the articular circumference of the radius, the *proximal radio-ulnar articulation.*

All three articulations are enclosed by a common *articular capsule*, which is broad and loose, especially anteriorly and posteriorly. It surrounds the olecranal, coronoid and radial fossae at the lower end of the humerus and is attached below to the ulna, close below the tip of the olecranon, to the border of the semilunar notch and to the tip of the coronoid process. The entire head of the radius and the greatest part of its neck is within the capsule. The *radial collateral ligament* extends from the lateral epicondyle of the humerus to the anular ligament, with which its fibres partly intermingle. The *ulnar collateral ligament* arises on the medial epicondyle of the humerus and passes, broadening as it goes, to the border of the semilunar notch of the ulna. The *anular ligament* is a dense firm band that surrounds the head of the radius like a sling. It arises from the anterior border of the semilunar notch of the ulna and is inserted into the posterior border of the radial notch of the same bone, forming with the latter notch the socket of the proximal radio-ulnar joint, $^3/_4$ of this socket being formed by the ligament and $^1/_4$ by the notch. On its inner surface, which is turned toward the cartilage-covered articular circumference of the head of the radius, the ligament is perfectly smooth. Below it the capsule is thin and projects slightly at the neck of the radius to form the *sacciform recess.*

Functionally considered the elbow joint is a combination of only two joints, since the humero-radial articulation does not act as an independent mechanism. There is, then, in the first place, the humero-ulnar articulation, which is a hinge joint and, secondly, the proximal radio-ulnar articulation, which is a pivot joint. The obtuse angle, open radially, formed by the upper and lower arm bones when the limb is extended, is termed the arm angle.

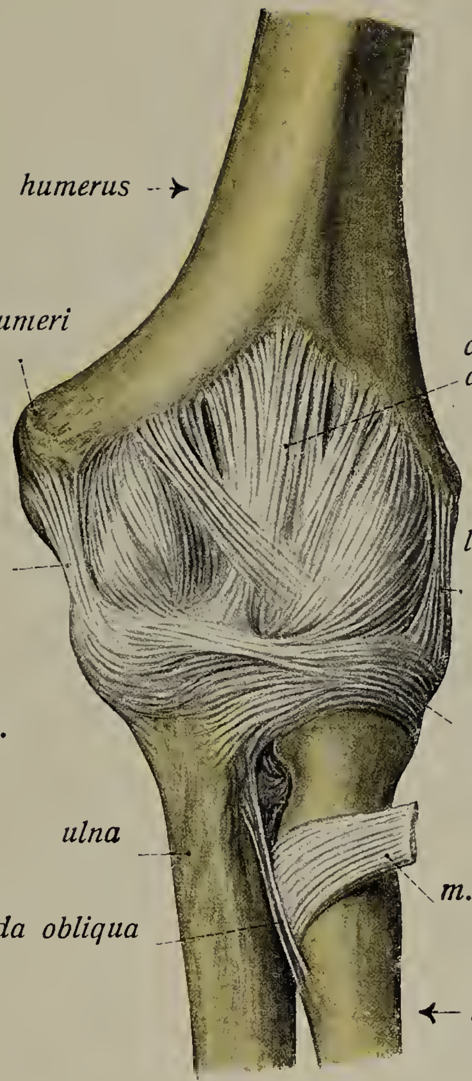


Fig. 201.

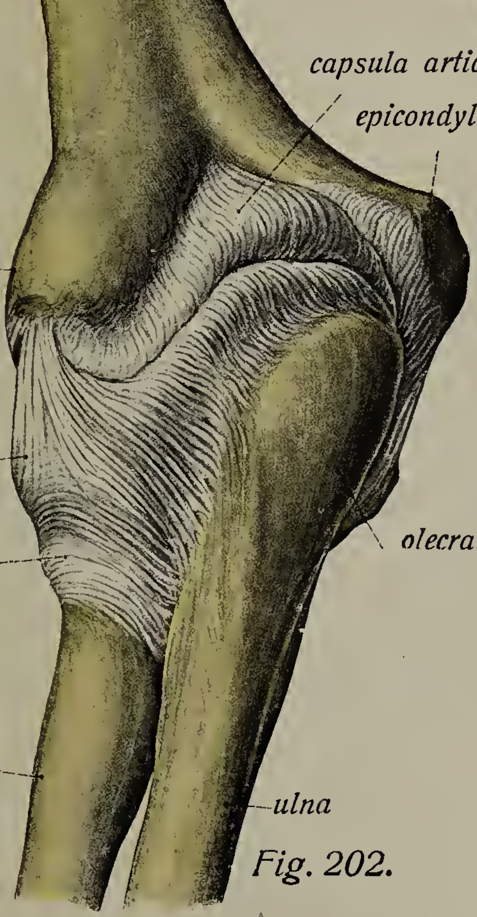


Fig. 202.

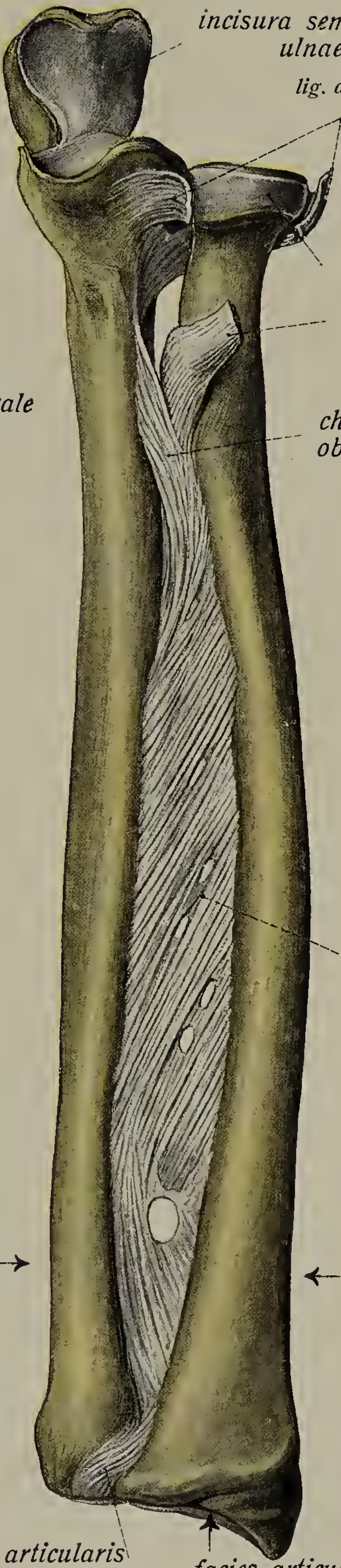

incisura semilunaris ulnae
lig. anulare radii ×
circumferentia articularis capit. radii
tendo m. bicipitis
chorda obliqua
membrana interossea
ulna
radius
capsula articularis articulationis radioulnaris distalis
facies articularis carpea radii

Fig. 203.

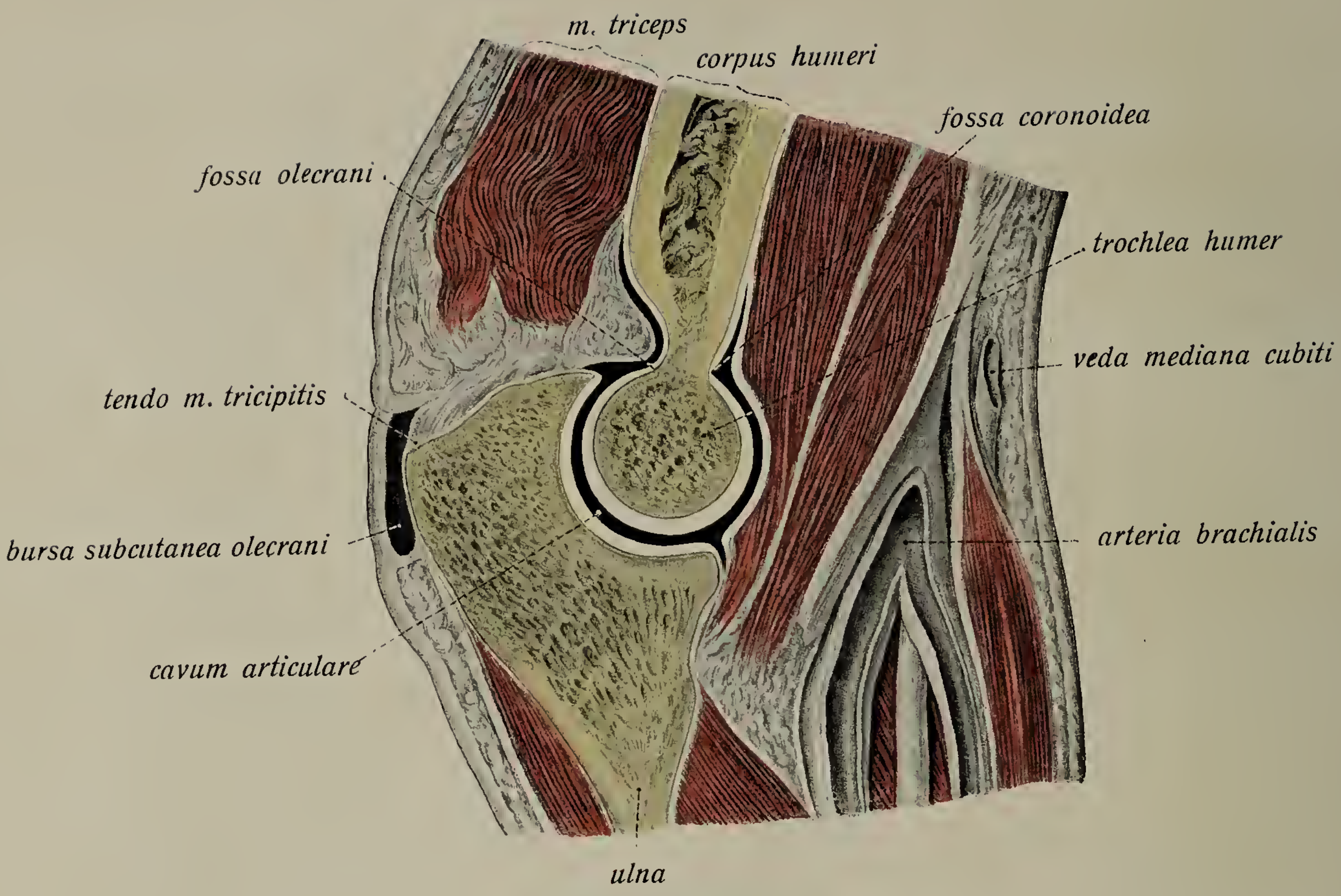


Fig. 204.

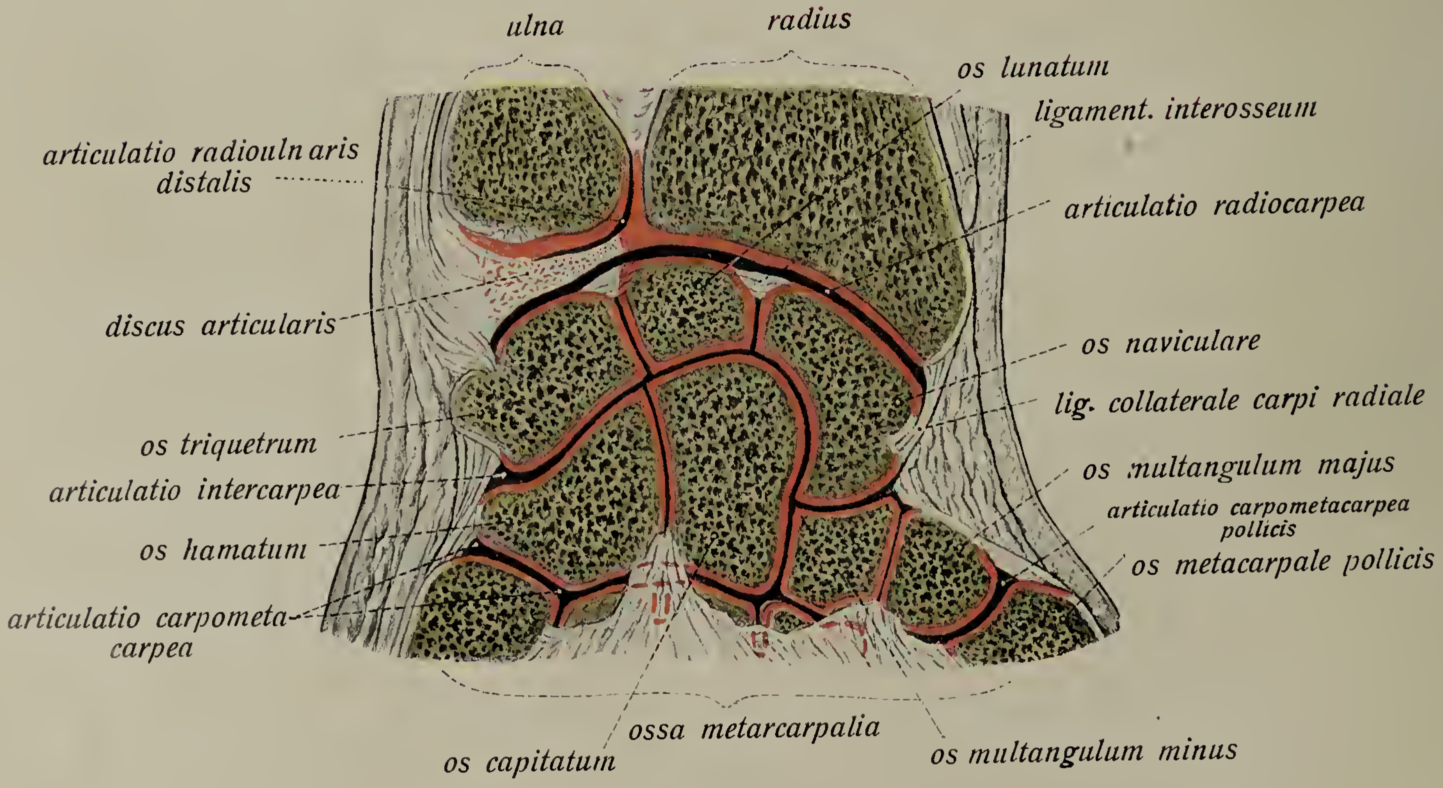


Fig. 205.

The Distal Radio-ulnar Joint, the Interosseous Membrane and the Radio-carpal Articulation.

Fig. 204. Sagittal section of the left elbow joint through the humero-ulnar articulation. ($^4/_5$)

Fig. 205. Section through the wrist joint, parallel to the dorsal surface of the hand. ($^4/_5$) The articular cartilages are red. The articular disk is stippled red.

The radius and ulna are connected throughout almost their entire length by the *interosseous membrane,* which is attached to the interosseous crests of the two bones, except above, where the interosseous space persists. In addition the two bones are united by the the chorda obliqua, which passes from the coronoid process of the ulna to the lower border of the tuberosity of the radius.

The *distal radio-ulnar articulation is* between the articular circumference of the head of the ulna and the ulnar notch of the radius and also the articular disk, which separates the head of the ulna from the cuneiform (triquetral) bone, the socket for the head of the ulna being formed partly by the ulnar notch and partly by the articular disk. Part of the socket is therefore nearly in the vertical plane and part almost horizontal so that the head of the ulna rests upon the lateral as well as the lower surface of the socket. The capsule sends a *sacciform recess* upwards between the two bones of the forearm. The *articular disk* is attached on the one hand to the ulnar border of the lower part of the radius, where it is continuous with the articular cartilage, and on the other hand to the styloid process of the ulna.

The Joints and Ligaments of the Hand.

The joints of the hand are those of the carpus and those of the fingers. The carpal joints are: 1. the radio-carpal; 2. the intercarpal; 3. that of the pisiform; 4. the carpo-metacarpal and 5. the carpo-metacarpal of the thumb. The finger joints are the metacarpo-phalangeal and the inter-phalangeal.

The *radio-carpal articulation* is between the carpal articular surface of the radius, together with the articular disk, and the proximal surfaces of the first row of carpal bones, the navicular and lunate articulating with the radius and the cuneiform (triquetrum) with the disk. The joint is completely separated from the intercarpal joint by short ligaments extending between the three bones, the navicular (scaphoid), lunate and cuneiform (triquetrum). The articular capsule is lax and thin and encloses the cartilaginous articulating surfaces.

The *intercarpal articulation* is between the first and second rows of carpal bones, the first row forming essentially the socket for the head of the os magnum (capitate) and the proximal part of the unciform (hamate). The line of the joint is S-shaped and its cavity usually communicates between the os magnum (capitate) and trapezoid (lesser multangular) with the carpo-metacarpal joint. The articular capsule is thin.

The Ligaments and Joints of the Hand. (Cont.)

The articulation of the pisiform bone is between the pisiform and cuneiform (triquetral) bones. The *piso-uncinate (piso-hamate)* and the *piso-metacarpal ligaments,* passing respectively from the pisiform to the hamulus of the unciform (hamate) and to the base of the fifth metacarpal, are merely continuations of the tendon of the flexor carpi ulnaris.

The *carpo-metacarpal articulation* is between the bases of the second to the fifth metacarpals and the distal articular surfaces of the trapezoid (lesser multangular), os magnum (capitate) and unciform (hamate). The joint cavity usually communicates with that of the intercarpal joint and sometimes is divided transversely into two parts. The articular capsule is tense and firm. The joint cavity extends a short distance between the bases of the metacarpals.

The *carpo-metacarpal articulation of the thumb* is always independent, neither communicating with the other carpo-metacarpal joints nor with the intercarpal. The articulating surfaces are saddle-shaped, more markedly so than in any other joint in the body.

Only one of the carpal ligaments arises from the ulna, the *ulnar collateral ligament,* which arises from the styloid process of that bone and is attached to the cuneiform (triquetrum). Corresponding to it on the radial side is the *radial collateral ligament,* passing from the styloid process of the radius to the navicular (scaphoid). In addition, the *dorsal radio-carpal ligament* extends obliquely from the dorsal surface of the lower end of the radius to the dorsal surfaces of the bones of the first row of the carpus, and the corresponding *volar radio-carpal ligament* passes, not only to the bones of the first row, but also to the os magnum (capitate). In the depth of the carpal groove, ligaments converge to the os magnum (capitate) forming the *radiate ligament.* The remaining carpal ligaments, which unite the carpal bones either with each other or with the metacarpals are the *volar* and *dorsal intercarpal,* the *volar* and *dorsal carpo-metacarpal* and three *volar* and four *dorsal interosseous* ligaments, these last filling the intervals between the bases of the metacarpals.

The metacarpo-phalangeal articulations are between the heads of the metacarpals and the bases of the proximal phalanges. Collateral ligaments strengthen their sides and *accessory volar ligaments* their volar surfaces, while the *transverse capitular ligaments* unite the heads of the four ulnar metacarpals. The articular capsules of the interphalangeal articulations are strengthened laterally by *collateral ligaments.* Imbedded in the metacarpo-phalangeal joint of the thumb there are two sesamoid bones, and smaller and inconstant ones may be found in the corresponding joint of the index and little fingers.

Fig. 206. The joint and ligaments of the hand, dorsal surface. $(^{3}/_{4})$

Fig. 207. The joints and ligaments of the hand, volar surface.
The transverse carpal ligament is removed, and the radial sesamoid bone of the thumb and one of the index finger and the little finger are exposed. $(^{3}/_{4})$

Fig. 208. The joints of the middle finger, from the side. $(^{2}/_{3})$

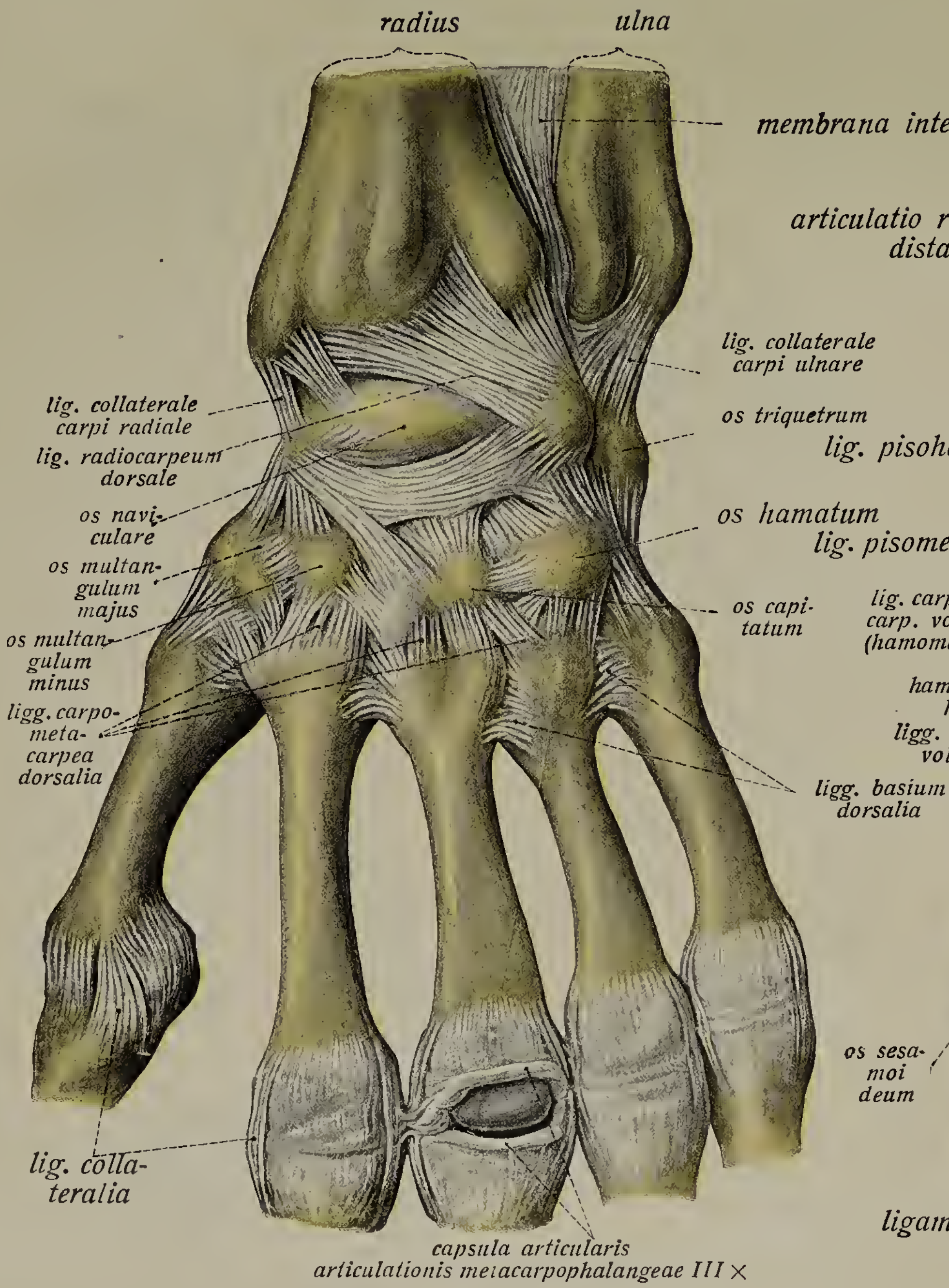

radius
ulna
membrana interossea
lig. collaterale carpi ulnare
lig. collaterale carpi radiale
os triquetrum
lig. radiocarpeum dorsale
os naviculare
os hamatum
os multangulum majus
os capitatum
os multangulum minus
ligg. carpometacarpea dorsalia
ligg. basium dorsalia
lig. collateralia
capsula articularis articulationis metacarpophalangeae III ×

Fig. 206.

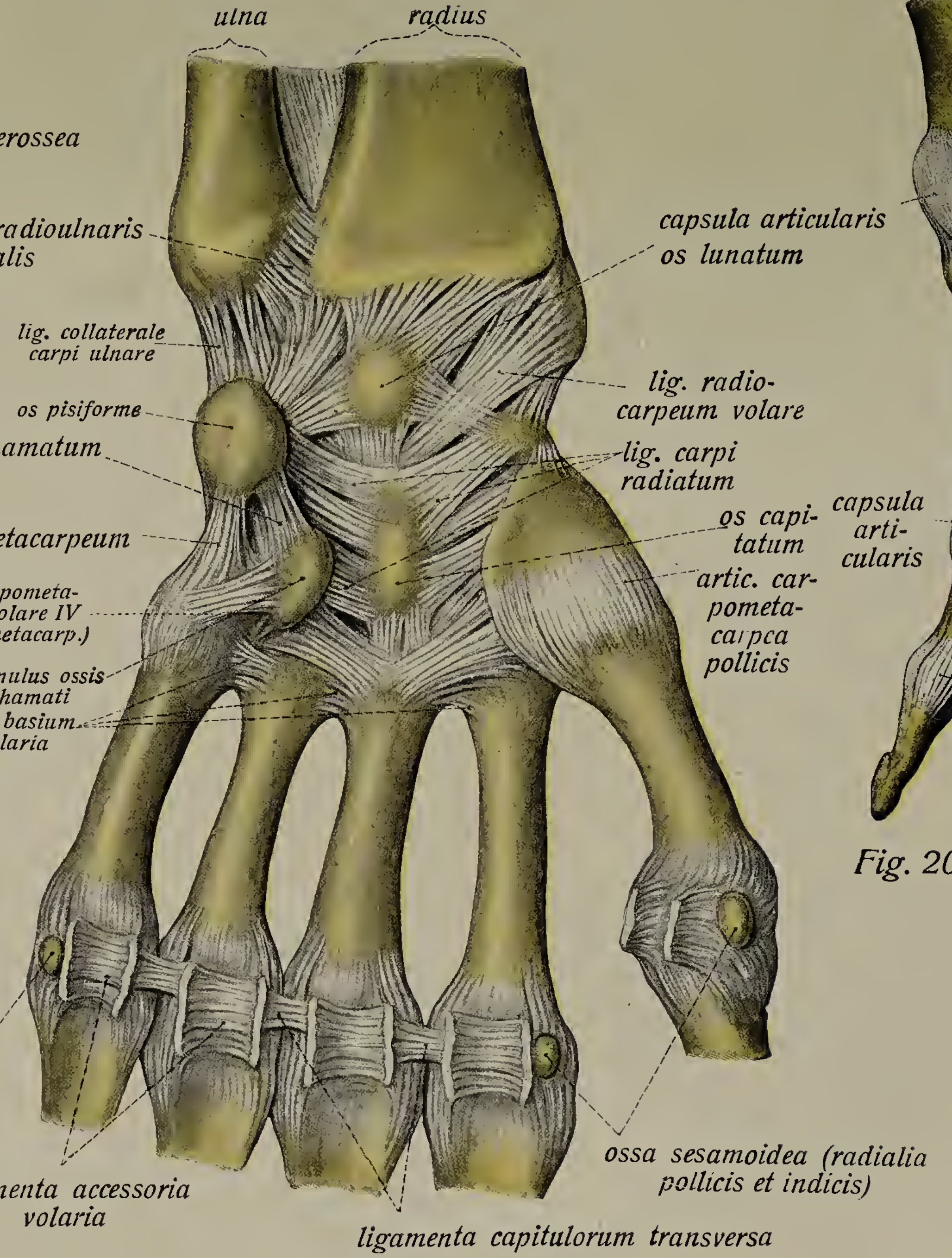

ulna
radius
articulatio radioulnaris distalis
capsula articularis
os lunatum
lig. collaterale carpi ulnare
lig. radiocarpeum volare
os pisiforme
lig. pisohamatum
lig. carpi radiatum
os capitatum
lig. pisometacarpeum
artic. carpometacarpea pollicis
lig. carpometacarp. volare IV (hamometacarp.)
hamulus ossis hamati
ligg. basium volaria
os sesamoideum
ossa sesamoidea (radialia pollicis et indicis)
ligamenta accessoria volaria
ligamenta capitulorum transversa

Fig. 207.

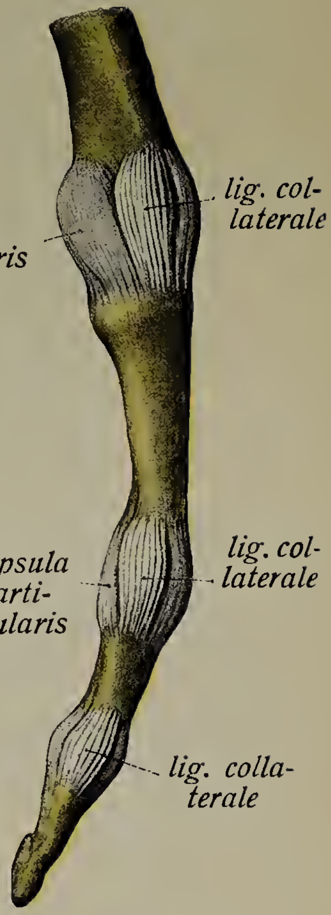


Fig. 208.

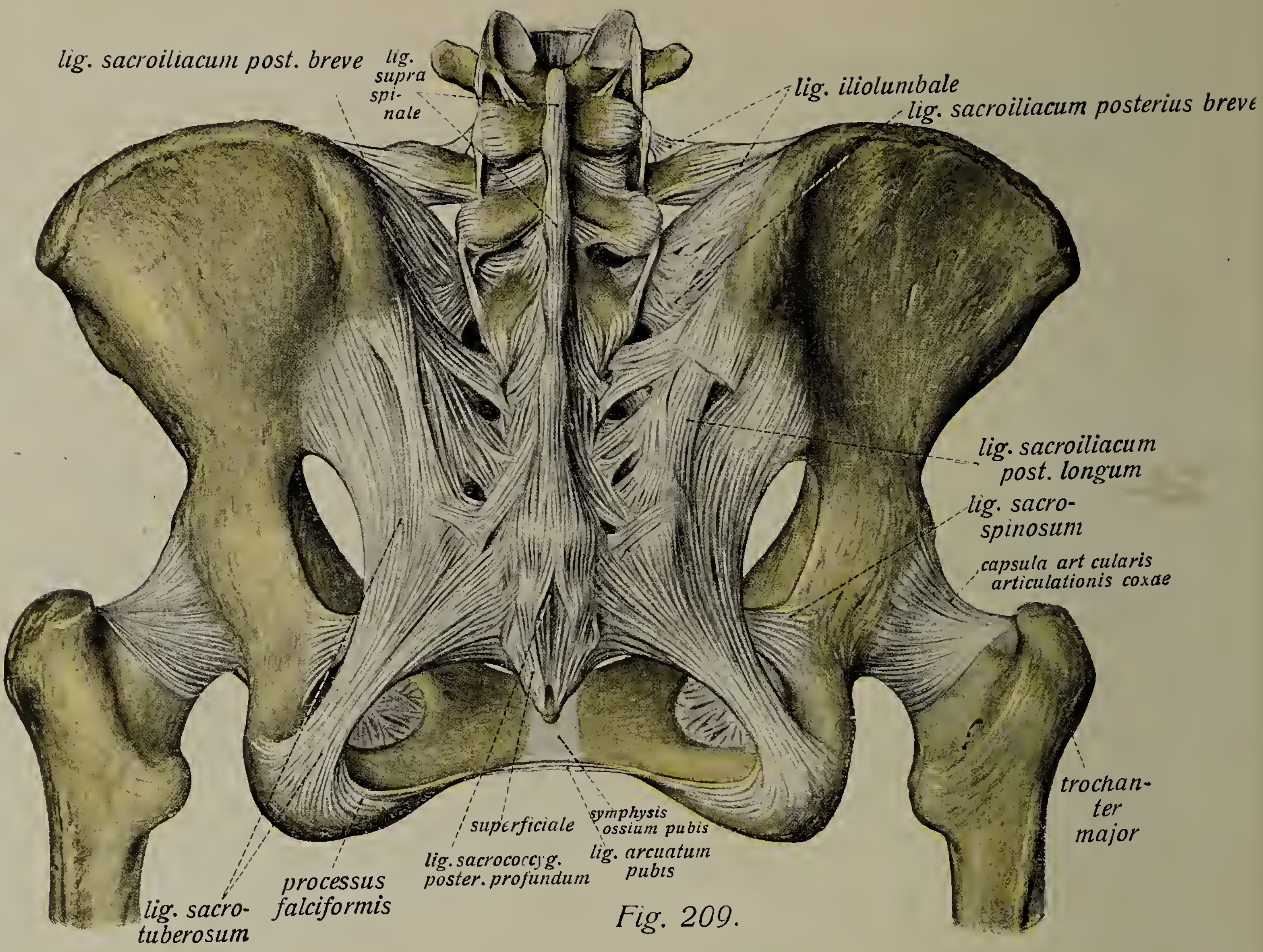

lig. sacroiliacum post. breve
lig. supra spinale
lig. iliolumbale
lig. sacroiliacum posterius breve
lig. sacroiliacum post. longum
lig. sacrospinosum
capsula articularis articulationis coxae
trochanter major
symphysis ossium pubis
superficiale
lig. arcuatum pubis
lig. sacrococcyg. poster. profundum
processus falciformis
lig. sacrotuberosum

Fig. 209.

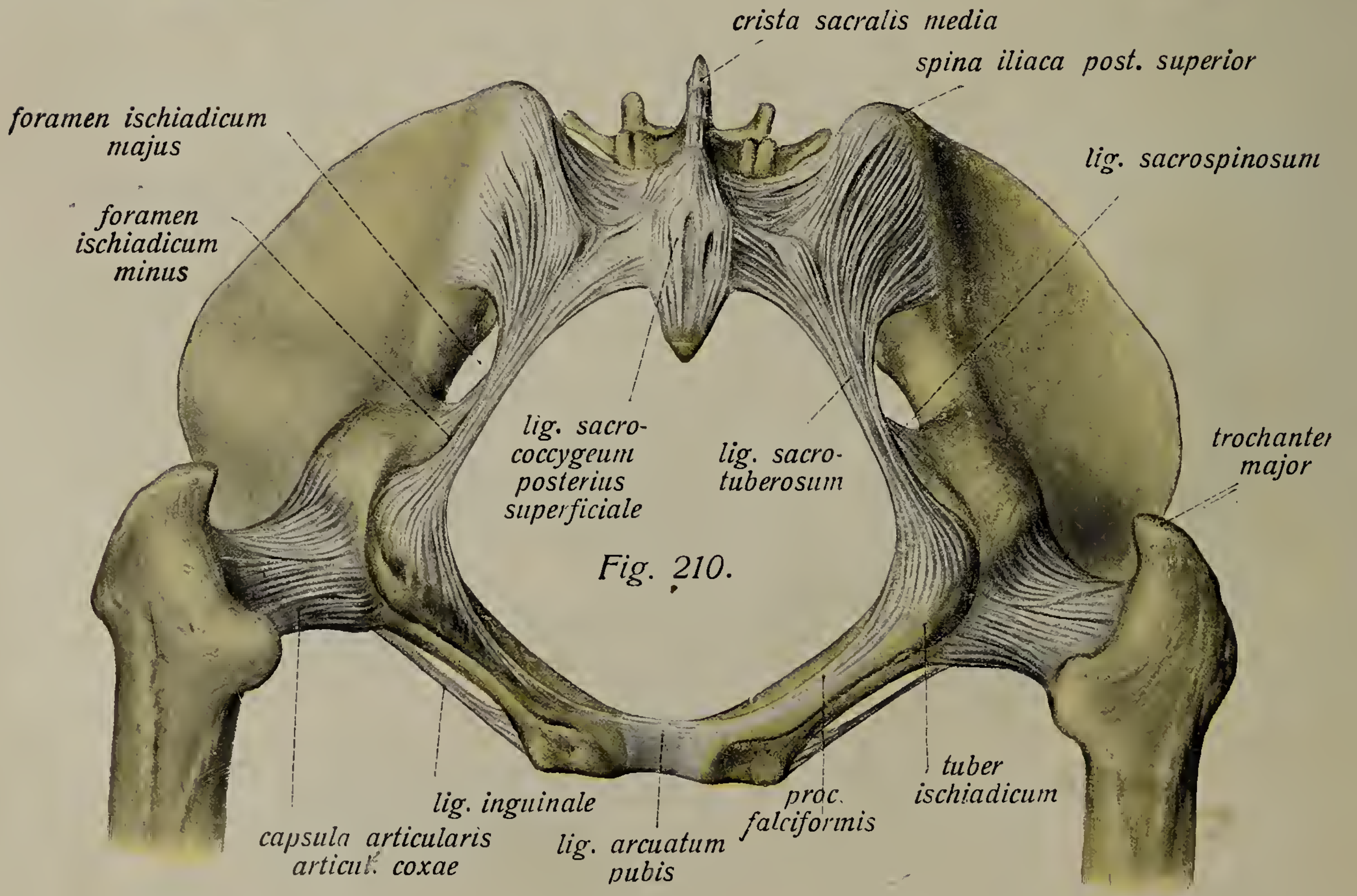

crista sacralis media
spina iliaca post. superior
foramen ischiadicum majus
lig. sacrospinosum
foramen ischiadicum minus
lig. sacrococcygeum posterius superficiale
lig. sacrotuberosum
trochanter major
tuber ischiadicum
lig. inguinale
proc. falciformis
capsula articularis articul. coxae
lig. arcuatum pubis

Fig. 210.

The Joints and Ligaments of the Lower Extremity.

The Joints and Ligaments of the Pelvic Girdle and the Sacro-coccygeal Ligaments.

Fig. 209. A female pelvis with its ligaments, from behind. ($^2/_5$)
On the right part of the superficial layer of the sacro-tuberous ligament is removed.
Fig. 210. A female pelvis with its ligaments, from below. ($^2/_5$)

The Sacro-coccygeal Ligaments.

The apex of the sacrum and the first coccygeal vertebra are united by the *sacro-coccygeal symphysis* and also by a number of rather unimportant ligaments. On the anterior surface is the *anterior sacro-coccygeal,* at the sides the *lateral sacro-coccygeal* and behind the *posterior sacro-coccygeal ligaments.* The last have a *superficial portion,* which unites the sacral and coccygeal cornua, and a *deep portion,* which is the lower end of the posterior longitudinal ligament (see p. 104).

The Ligaments of the Pelvic Girdle.

The *symphysis pubis* is an amphiarthrosis uniting the symphyseal surfaces of the two pubic bones. The union is by an *interpubic fibrocartilage,* which frequently contains a slit-like cavity. Strengthening the symphysis there is a *superior pubic ligament,* which stretches from one pubic tubercle to the other over the upper border of the symphysis, and an *arcuate ligament* at the lower border.

The posterior joint of the pelvic girdle, the *sacro-iliac articulation* is paired and is formed by the auricular surfaces of the sacrum and ilium. It is an almost immoveable joint, since the irregular curved and uneven surfaces do not lend themselves to any extensive movement. The contact of the two bones is further maintained by a strong ligament, the *interosseous ligament,* which unites the tuberosities of the bones, so that these are united anteriorly by a joint, posteriorly by a syndesmosis.

In addition to the interosseous ligament there is also a *posterior sacro-iliac ligament,* which consists of a superficial *long* and a deep *short sacro-iliac ligament* and is formed by a number of oblique fibre bundles that pass from the posterior part of the tuberosity of the sacrum to the crest of the ilium in the neighborhood of the posterior superior spine. A weaker *anterior sacro-iliac ligament* is merely a thickening of the anterior surface of the articular capsule.

The Joints and Ligaments of the Pelvic Girdle. (Cont.)

Fig. 211. A male pelvis with its ligaments, from in front. ($^2/_5$)
Fig. 212. A female pelvis with its ligaments, from in front. ($^2/_5$)

Finally the *ilio-lumbar ligament* unites the ilium to the fifth lumbar vertebra. It is a strong band which passes from the transverse process of the fifth (sometimes also the fourth) lumbar vertebra to the crest of the ilium. By it the last lumber vertebra and the last intervertebral fibrocartilage become part of the boundary of the pelvis.

The Independent Ligaments of the Pelvis.

The *obturator membrane* closes the obturator foramen, except for a small area at the upper part of the foramen where the obturator groove begins.

The *sacro-tuberous (great sacro-sciatic) ligament* arises from the lateral portions of the posterior surfaces of both the sacrum and coccyx, from the posterior part of the crest of the ilium and its posterior superior and inferior spines. It concentrates to a broad firm band which is attached to the ischial tuberosity. A prolongation of it along the lower borders of the inferior rami of the ischium and pubis is termed the *falciform process*.

The much shorter *sacro-spinous (lesser sacro-sciatic) ligament* lies on the pelvic side of the sacro-tuberous and arises from the lateral border of the lower part of the sacrum and of the upper part of the coccyx; it is inserted into the spine of the ischium. It converts the great sacro-sciatic notch into a roundish, quadrangular foramen, the *great sacro-sciatic foramen*. With the sacro-tuberous ligament it converts the lesser sacro-sciatic notch into the *lesser sacro-sciatic foramen*. The sacro-spinous ligament separates these two foramina and forms part of the pelvic outlet.

The Pelvis as a Whole.

The pelvis is bounded by the following bones, the innominates *(coxae)*, the sacrum, the coccyx and the fifth lumbar vertebra. In additition certain ligaments or membranes take part in its boundaries, the interpubic fibrocartilage, the obturator membrane and the sacro-spinous, sacro-tuberous and ilio-lumbar ligaments.

There may be distinguished a great or false pelvis *(pelvis major)* and a small or true pelvis *(pelvis minor)*. The former is much more capacious than the latter and it is only partly bounded by bones, the ala of the ilia and the fifth lumbar vertebra. Its separation from the true pelvis is indicated by the linea terminalis.

The true pelvis is a short canal with for the most part bony walls, the front wall being quite short, while the posterior one is markedly longer.

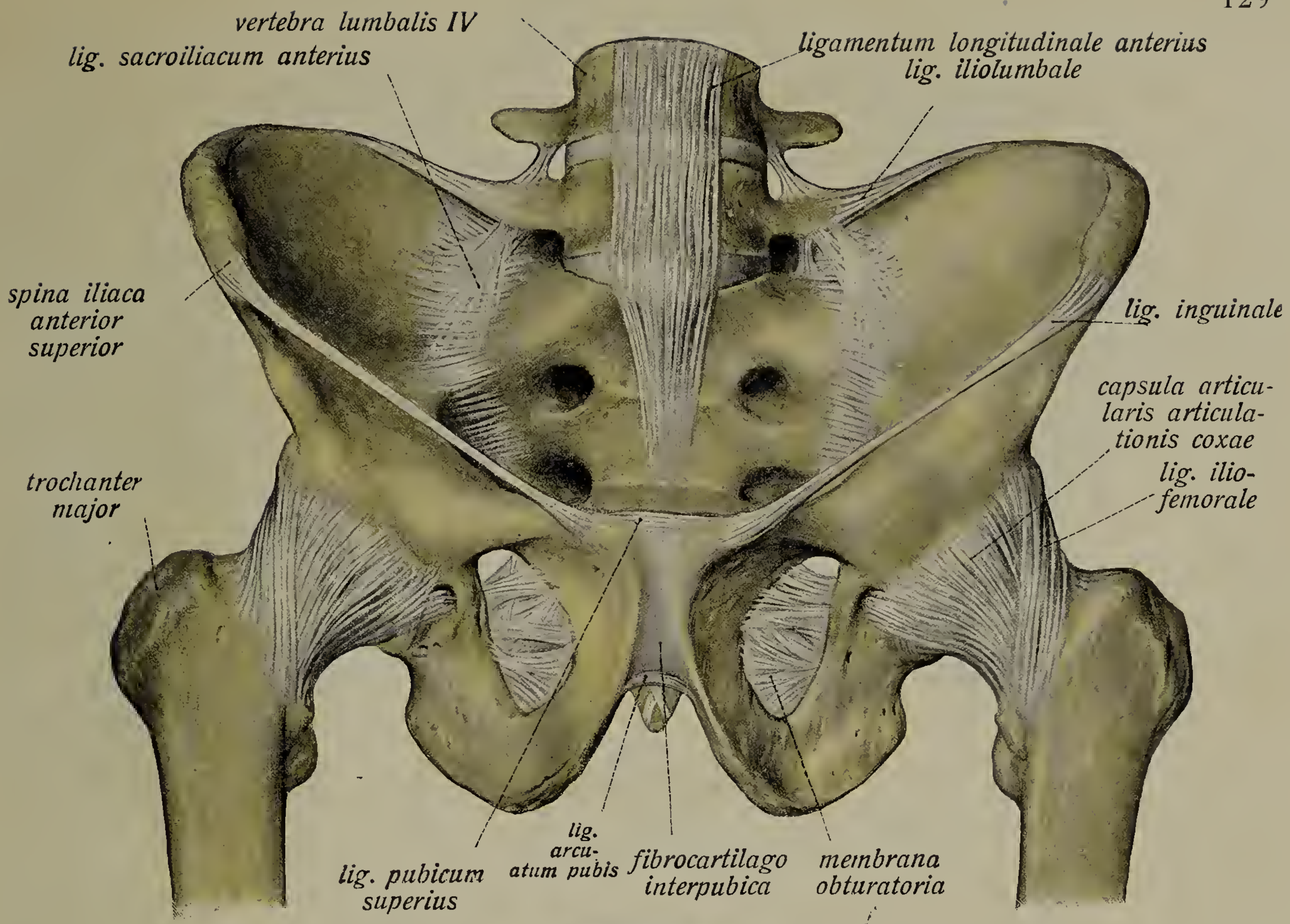

vertebra lumbalis IV
lig. sacroiliacum anterius
ligamentum longitudinale anterius
lig. iliolumbale
spina iliaca anterior superior
lig. inguinale
capsula articularis articulationis coxae
lig. iliofemorale
trochanter major
lig. pubicum superius
lig. arcuatum pubis
fibrocartilago interpubica
membrana obturatoria

Fig. 211.

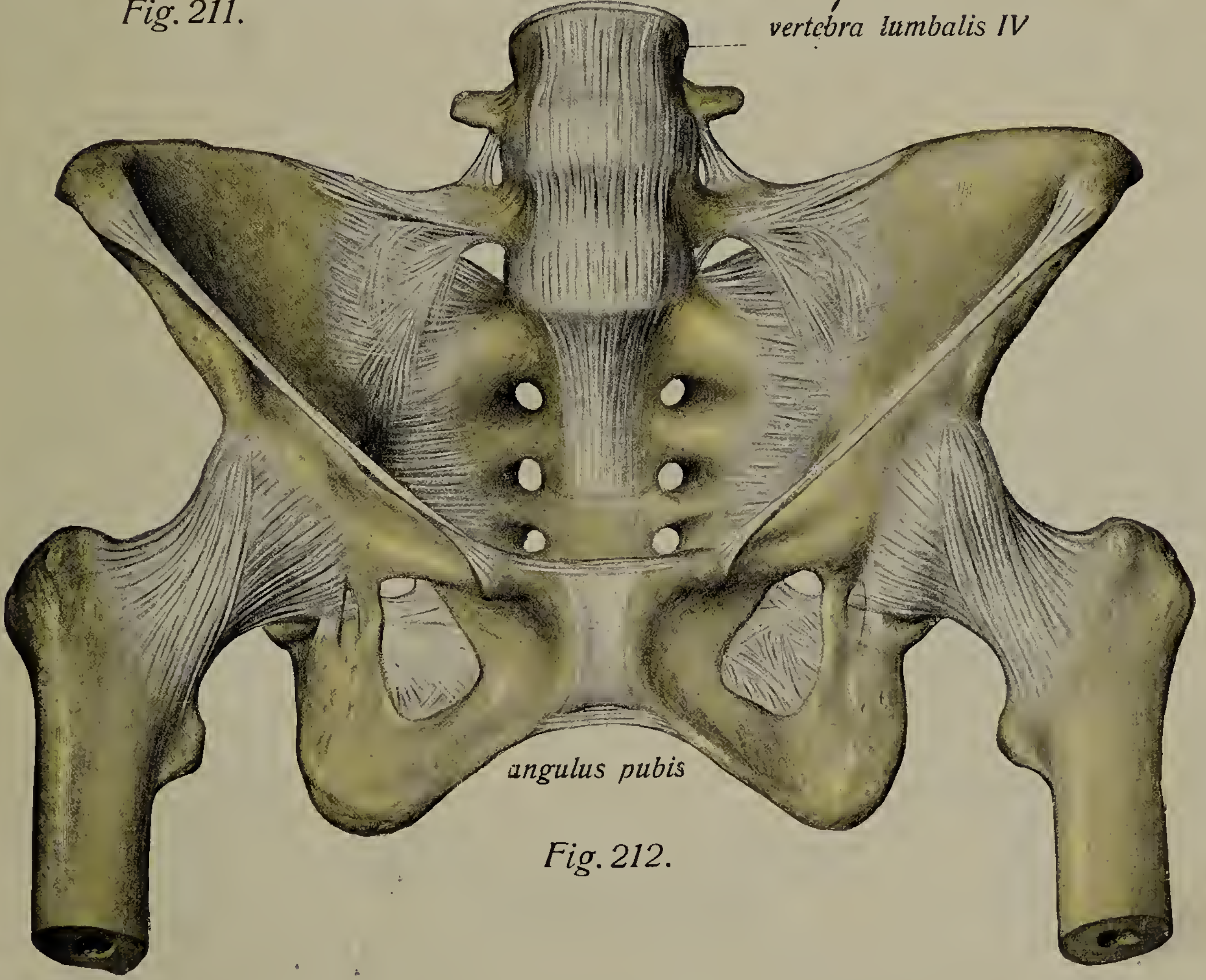


Fig. 212.

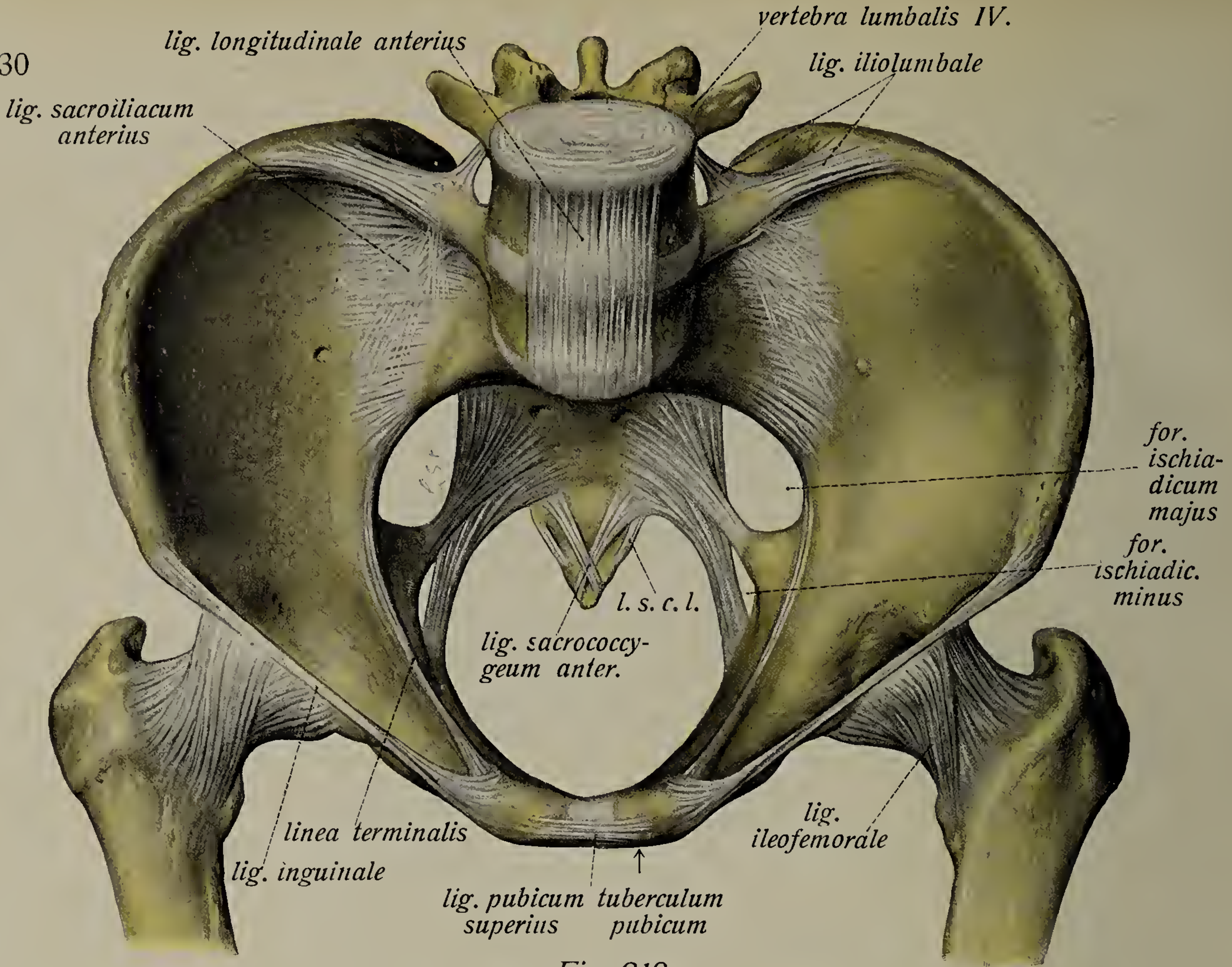


Fig. 213.

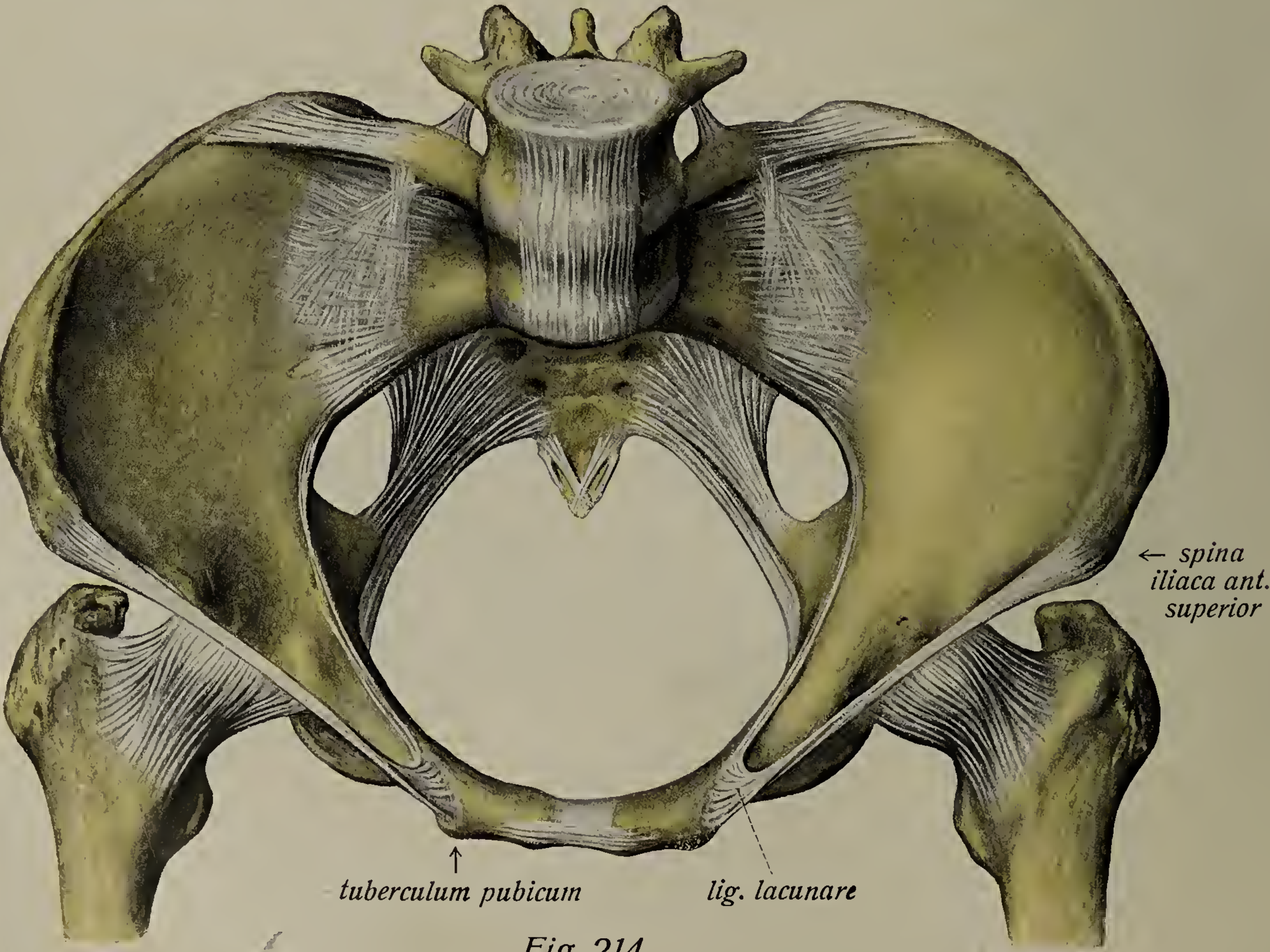


Fig. 214.

The Joints and Ligaments of the Pelvis. (Cont.)

Fig. 213. A male pelvis with its ligaments, from above. ($^2/_5$)
l. s. c. l. = lateral sacro-coccygeal ligament.
Fig. 214. A female pelvis with its ligaments, from above. ($^2/_5$)

The inlet of the true pelvis *(apertura superior)* is bounded by the promontory the three parts, sacral, iliac (linea arcuata) and pubic (pecten) of the terminal line and the upper border of the interpubic fibrocartilage or rather the superior pubic ligament.

The boundaries of the pelvic *cavity* are, behind, the concave pelvic surface of the sacrum and the anterior surface of the coccyx; laterally the pelvic surfaces of the bodies of the ilium, ischium and pubis, the sacro-tuberous and sacro-spinous ligaments, the rami of the pubis and ischium and the obturator membranes; anteriorly, the symphysis pubis and the anterior ends of the pubic bones. The anterior wall is by far the shortest, the posterior the longest. Posteriorly on the lateral walls are the two sacrosciatic foramina, the upper and larger one being rounded quadrangular, and the lower smaller one triangular.

The outlet *(apertura inferior)* is bounded by the arcuate ligament, the symphysis, the ischial tuberosities, the inferior rami of the pubis and ischia, the sacro-tuberous ligaments and the apex and lateral borders of the coccyx. In contrast to the inlet the boundary of the outlet is not in one plane. Its deepest point is formed by the coccyx and the ischial tuberosities also project strongly downwards, while in the region of the sacro-tuberous ligament and symphysis pubis the boundary slopes to a higher level. The angle that the two lower pubic rami form with the symphysis is termed the *pubic angle* and is somewhat rounded off to a *pubic arch* by the arcuate ligament.

The pelvis is not placed horizontally in the body but is inclined. Its inclination varies, being on the average about 60°.

The pelvis, and especially the true pelvis, more than any other part of the skeleton shows sexual differences. In the female the false pelvis is lower, broader and flatter, and the ala of the ilium are usually less strongly concave. The cavity of the true pelvis is larger. Its inlet in the male is heart-shaped on account of the greater projection of the promontory; in the female it is transversely oval. The outlet in the male is more strongly narrowed than in the female, owing to the ischial tuberosities being somewhat convergent. The pubic angle in the male is acute, about 75°; in the female it is a right angle or obtuse, 90° to 100°. For the inguinal ligament see p. 132.

The Hip Joint *(articulatio coxae).*

Fig. 215. The right hip joint from in front. ($^2/_3$)
Fig. 216. The right hip joint from behind. ($^2/_3$)
Fig. 217. The socket of the right hip joint after cutting through the capsule and the ligamentum teres. The head of the femur has been removed. ($^3/_4$)

The *inguinal ligament* (Poupart's) arises from the anterior superior spine of the ilium and passes, tensely stretched, to the pubic tubercle, where it has a broadened insertion. An almost horizontal reflexion of the ligament extends from the insertion to the upper border of the superior ramus of the pubis, forming the *lacunar ligament* (Gimbernat's). The inguinal ligament is the tendinous lower edge of the abdominal muscles and fasciae, and does not properly belong to the ligaments of the pelvis.

The Hip Joint *(articulatio coxae).*

The *hip joint (articulatio coxae)* is between the acetabulum of the innominate bone and the head of the femur. The socket is materially deepened by a strong, fibrocartilaginous *glenoidal lip,* triangular in cross section, so that it embraces more than half the spherical head. Consequently the joint is a typical ball and socket arrangement (enarthrosis). The glenoidal lip bridges the acetabular notch, converting it into a wide foramen; in this part of its extent the lip is termed the *transverse ligament.*

The *articular capsule* is greatly strengthened by reinforcing bands and is the strongest in the body. It takes origin around the base of the glenoidal lip and encloses not only the head of the femur but also the greater part of its neck. Anteriorly it is attached to the intertrochanteric line, but posteriorly it does not extend so far down, enclosing on that surface only a little more than half the neck*).

The reinforcing ligaments of the *capsule* are firmly united with it and may be either longitudinal or circular. The latter, forming the *orbicular zone,* surround the neck of the femur at its narrowest part and have a circular course in the inner layers of the capsule, firmly united to the longitudinal fibre bundles. A longitudinal ligament arises from each of the constituent parts of the innominate bone and they are thus three in number, the *ilio-femoral,* the *pubo-capsular* and the *ischio-capsular.*

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*) On account of the thickness of the capsule the extent of the joint cavity is somewhat less.

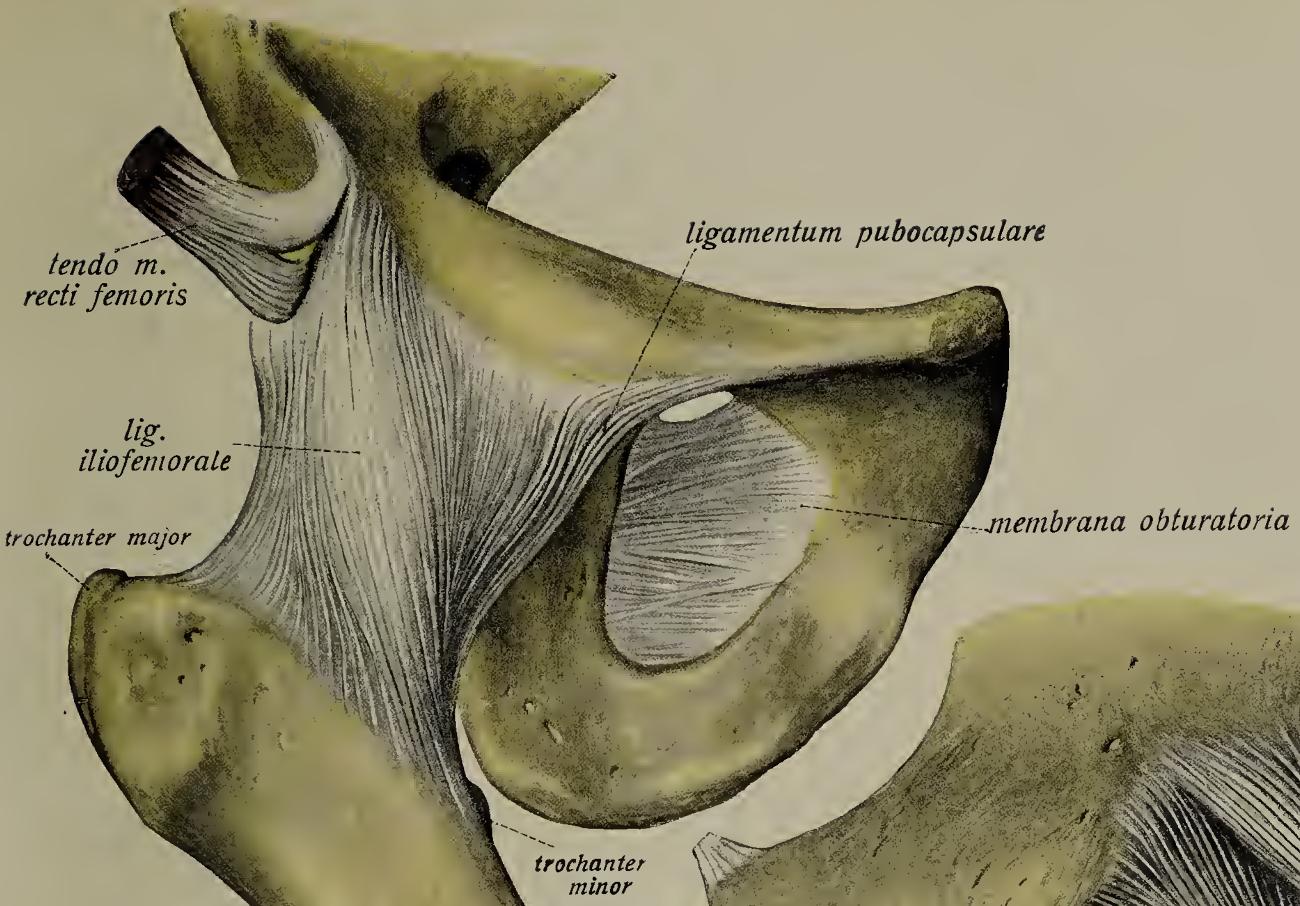


Fig. 215

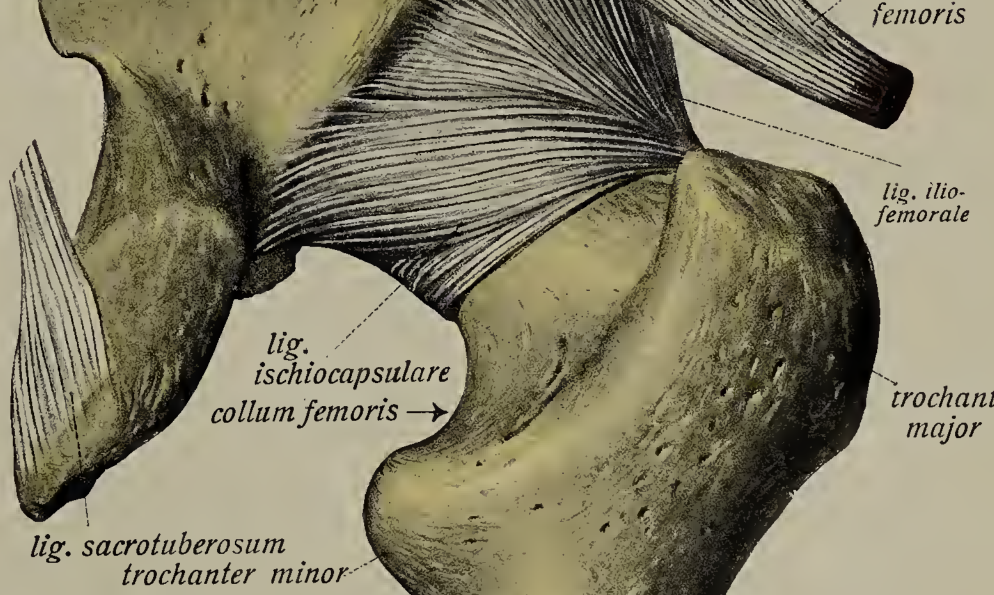


Fig. 216.

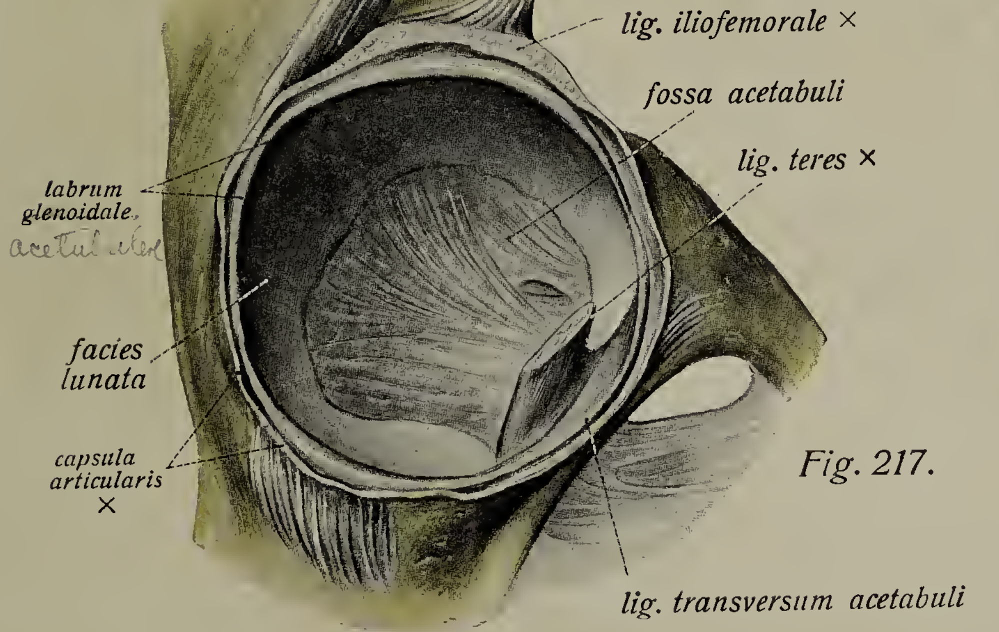


Fig. 217.

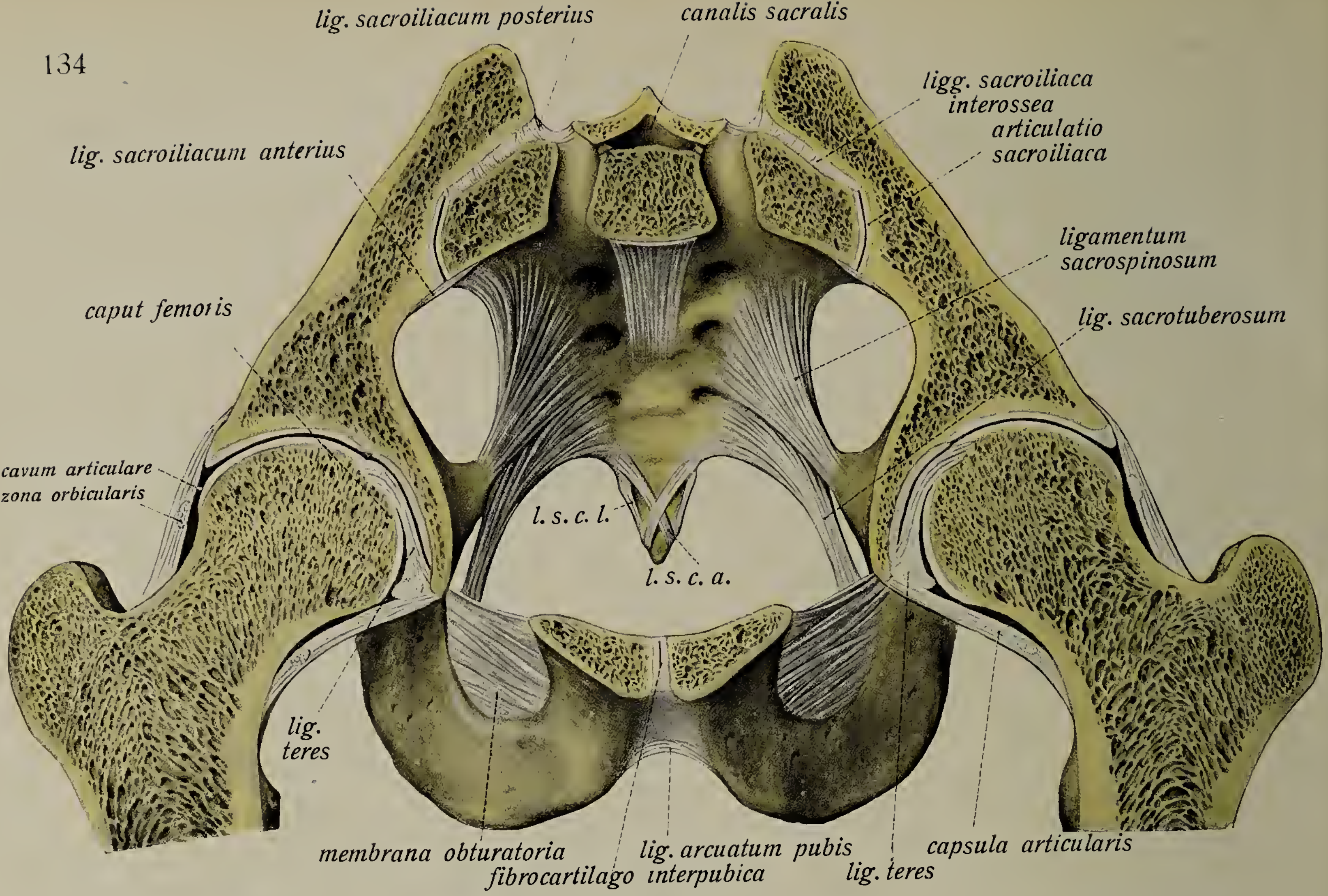


Fig. 218.

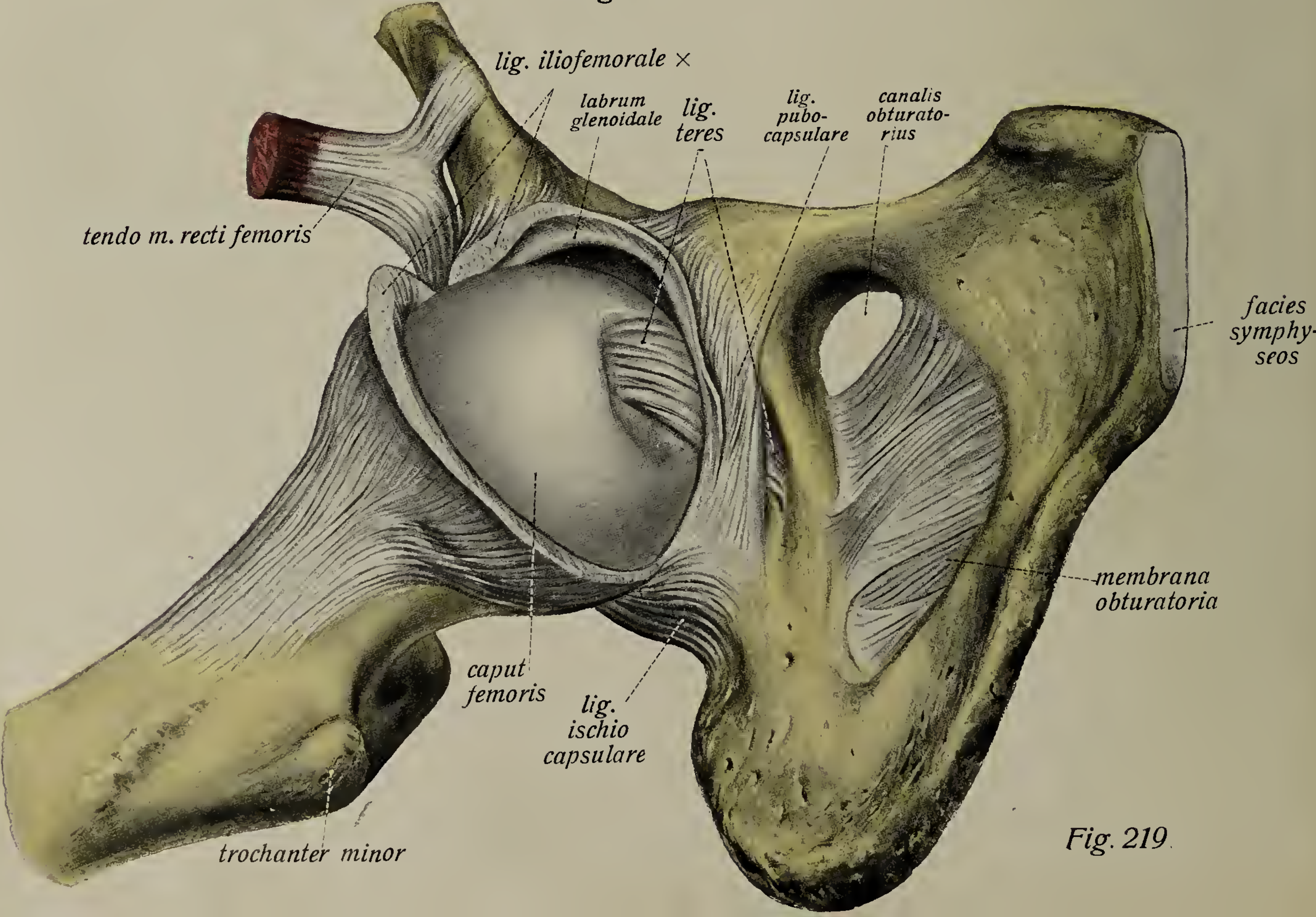


Fig. 219

The Hip Joint *(articulatio coxae).* (Cont.)

Fig. 218. A section through the pelvis and both hip joints, almost perpendicular to the axis of the pelvis. ($^2/_3$) In addition the preparation shows also the symphysis pubis with its interpubic fibrocartilage, the sacro-iliac articulations, the pelvic surfaces of the sacro-spinous and sacro-tuberous ligaments and the anterior and lateral sacro-coccygeal ligaments.

l. s. c. l. = lateral sacro-coccygeal ligament.
l. s. c. a. = anterior sacro-coccygeal ligament.

Fig. 219. The right hip joint opened by cutting through the anterior wall of the capsule to show the ligamentum teres. The head of the femur has been withdrawn from its socket, and strongly rotated outward and backward. ($^3/_4$)

Much the strongest of the three ligaments is the thick *ilio-femoral ligament*, one of the thickest ligaments of the body. It arises from the body of the ilium in the region of the anterior inferior spine and passes obliquely on the anterior surface of the capsule to the intertrochanteric line, which is produced by the ligament. The *pubo-capsular ligament* arises from the upper ramus of the pubis and passes on the medial surface of the capsule toward the lesser trochanter. The *ischio-capsular ligament* arises from the body of the ischium and passes on the posterior wall of the capsule for the most part to the orbicular zone, but in part also beyond this towards the lesser trochanter.

It is a peculiarity of the hip joint that its socket is not lined with cartilage over the area of the acetabular fossa, this being occupied by a pad of fat. From it as well as from the acetabular notch a characteristic ligament arises, the *ligamentum teres*, which is a flat, but sometimes strong, band that is inserted into the fovea on the head of the femur. In the complete joint it lies upon the fat pad of the acetabular fossa and on account of its length and weakness does not limit materially the movements in the joint.

The thinnest parts of the capsule are situated on its lower wall, between the pubo-capsular and ischio-capsular ligaments and above the orbicular zone, between the ischio-capsular and ilio-femoral ligaments. The anterior wall is also thin between the ilio-femoral and pubo-capsular ligaments, where occasionally a communication occurs between the joint cavity and the *ilio-pectineal bursa*, situated beneath the ilio-psoas muscle.

The Knee Joint *(articulatio genu).*

Fig. 220. The right knee joint in the extended condition, from in front. ($^2/_3$)
Fig. 221. The right knee joint in the extended condition, from behind. ($^2/_3$)

The *knee joint (articulatio genu)* is between the condyles and patellar surface of the femur on the one hand and the condyles of the tibia on the other. In addition, the articular surface on the posterior surface of the patella takes a passive part in the formation of the joint.

On account of its form and the multiplicity of its parts the knee joint is one of the most complicated joints of the body. The line of attachment of the *articular capsule* follows in general the margins of the cartilage-covered surfaces; on the posterior surface of the femur the intercondyloid line indicates the line of attachment, so that the whole intercondyloid fossa is included in the joint cavity.

The *tibial collateral ligament* is connected with the capsule. It arises from the medial epicondyle of the femur and passes, always intimately connected with the capsule, by its superficial fibres to the medial border of the tuberosity of the tibia and by short deep fibres, directed obliquely backwards, to the medial meniscus and the infraglenoid margin of the medial condyle of the tibia. The *fibular collateral ligament*, on the contrary, is for the most part separated from the capsule by fat tissue and consequently appears as an independent firm, rather flat ligament, extending between the lateral epicondyle of the femur and the head of the fibula.

On the posterior wall of the capsule there are two reinforcing ligaments. The *oblique popliteal ligament* is a prolongation of the tendon of the semi-membranous muscle and runs obliquely from below and medial, upwards and laterally over the posterior surface of the capsule, in which it loses itself. The *arcuate popliteal ligament* is an arched band which curves over the tendon of origin of the popliteus muscle and also radiates out in the capsule. Some of its fibres pass to the head of the fibula and form what is termed the *retinaculum* of the arcuate ligament.

The anterior wall of the knee joint is formed almost entirely by the tendon of the quadriceps muscle and the patella. The quadriceps tendon is actually attached to the base of the patella, but it is continued by the flat, very strong *patellar ligament*, which passes from the apex of the patella to the tuberosity of the tibia. It is independent of the knee joint and unconnected with its capsule. A constant *deep infrapatellar bursa*, separates the ligament from the anterior surface of the upper part of the tibia. Tendinous prolongations from the quadriceps tendon, the *medial* and *lateral patellar retinacula*, strenghten the anterior part of the articular capsule.

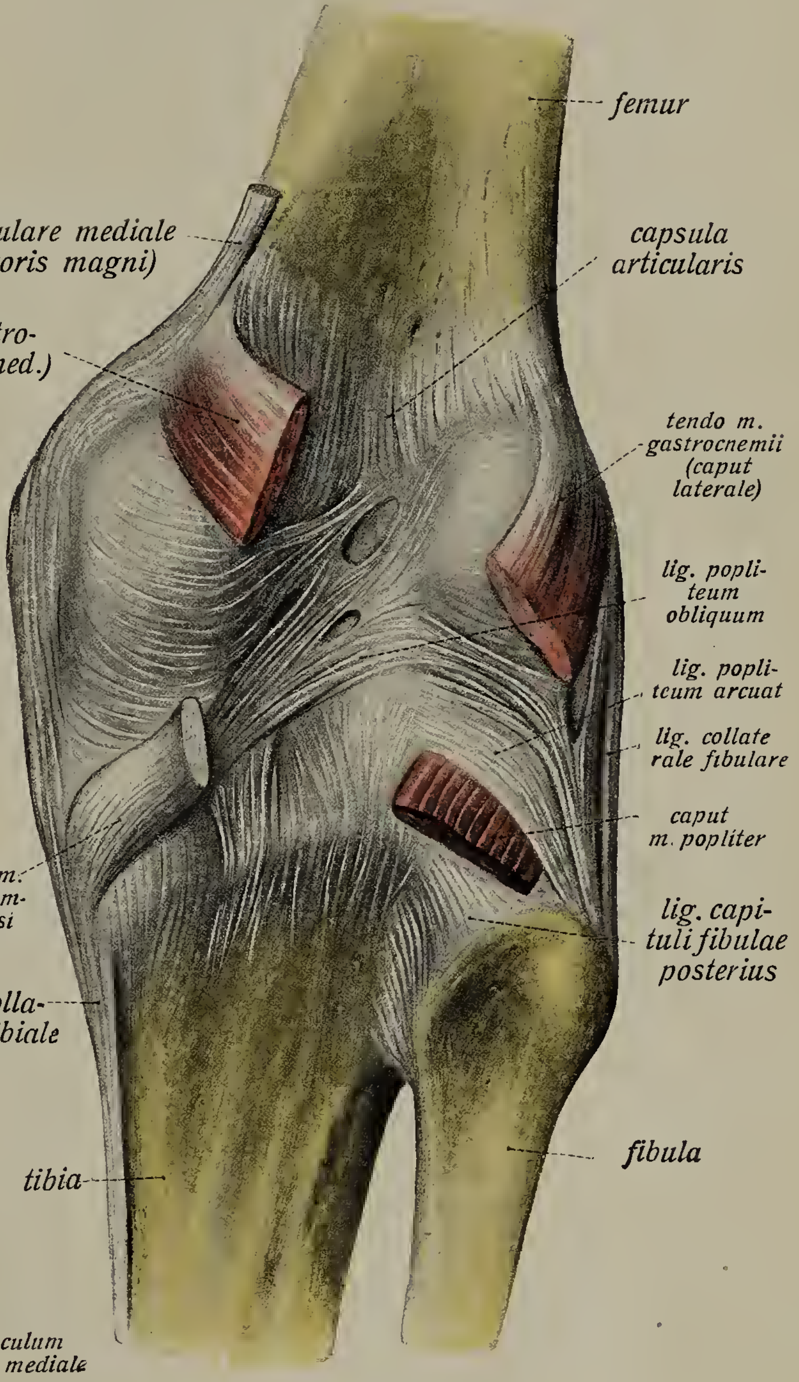

femur
septum intermusculare mediale (tendo m. adductoris magni)
capsula articularis
tendo m. gastrocnemii (caput med.)
tendo m. gastrocnemii (caput laterale)
lig. popliteum obliquum
lig. popliteum arcuat
lig. collaterale fibulare
caput m. popliter
tendo m. semimembranosi
lig. capituli fibulae posterius
lig. collaterale tibiale
tibia
fibula

Fig. 221.

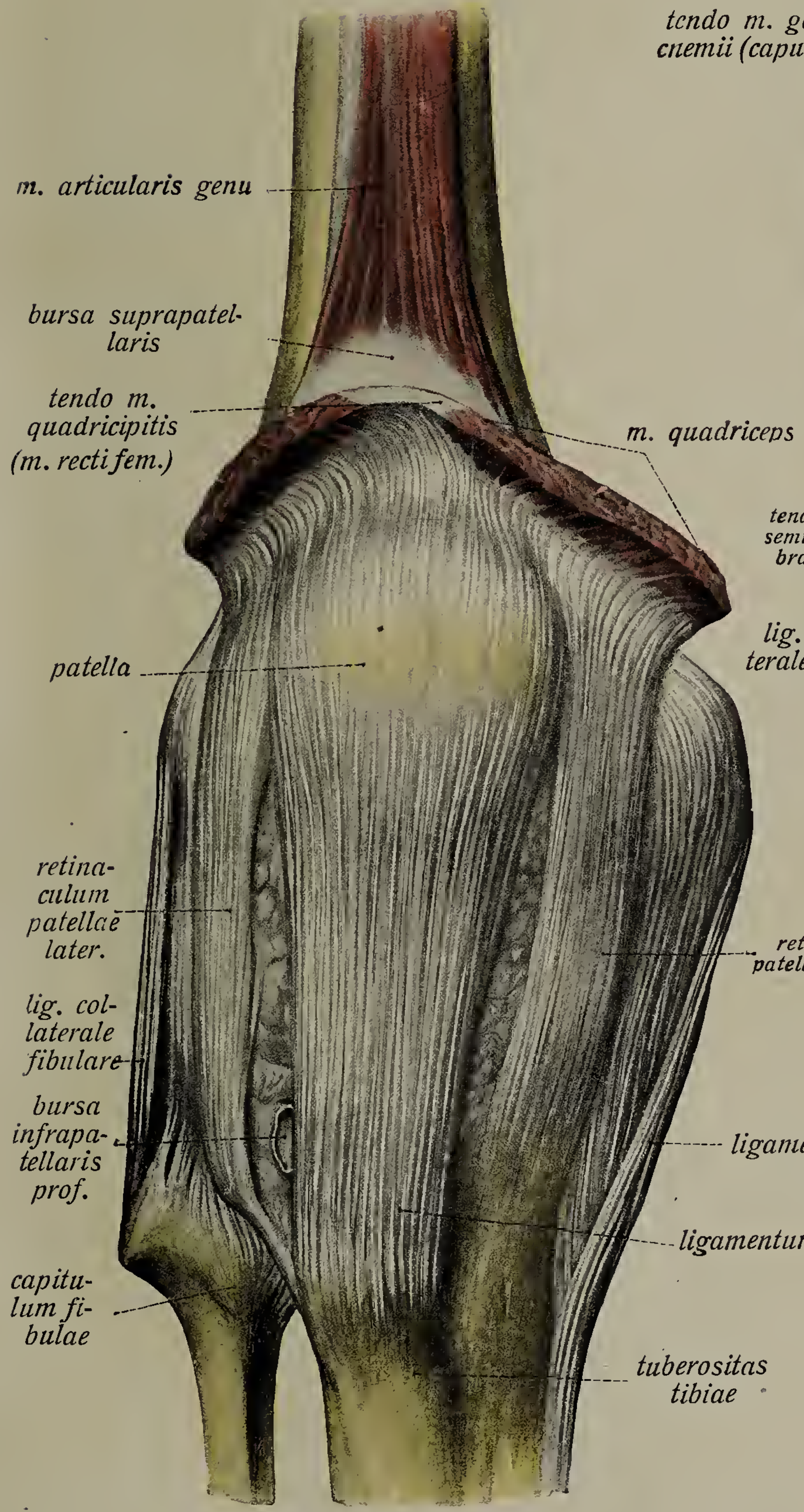

m. articularis genu
bursa suprapatellaris
tendo m. quadricipitis (m. recti fem.)
m. quadriceps
patella
retinaculum patellae later.
retinaculum patellae mediale
lig. collaterale fibulare
bursa infrapatellaris prof.
ligamentum collaterale tibiale
ligamentum patellae
capitulum fibulae
tuberositas tibiae

Fig. 220.

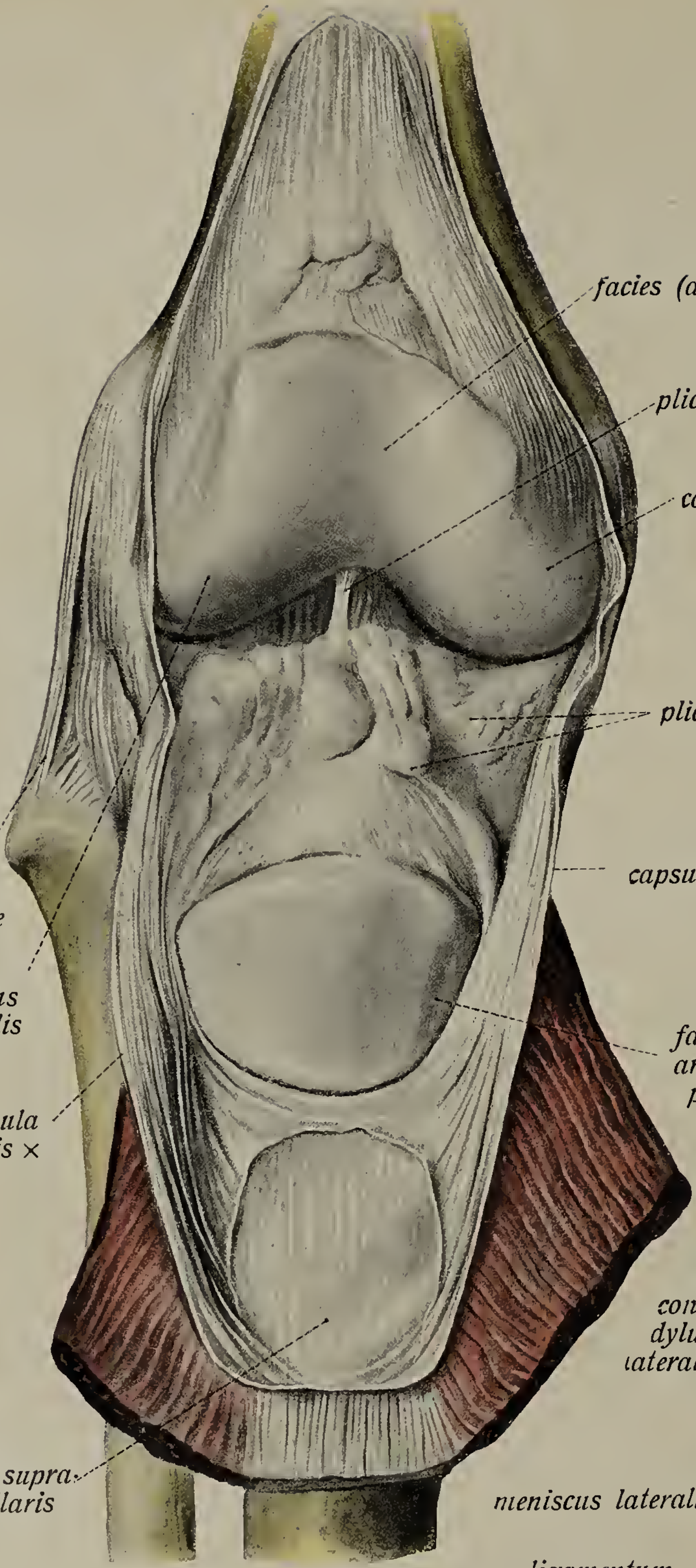

facies (articularis) patellaris
plica synovialis patellaris
condylus medialis femoris
plica alaris
capsula articularis ×
lig. collaterale fibulare
condylus lateralis
facies articularis patellae
capsula articularis ×
bursa suprapatellaris

Fig. 222.

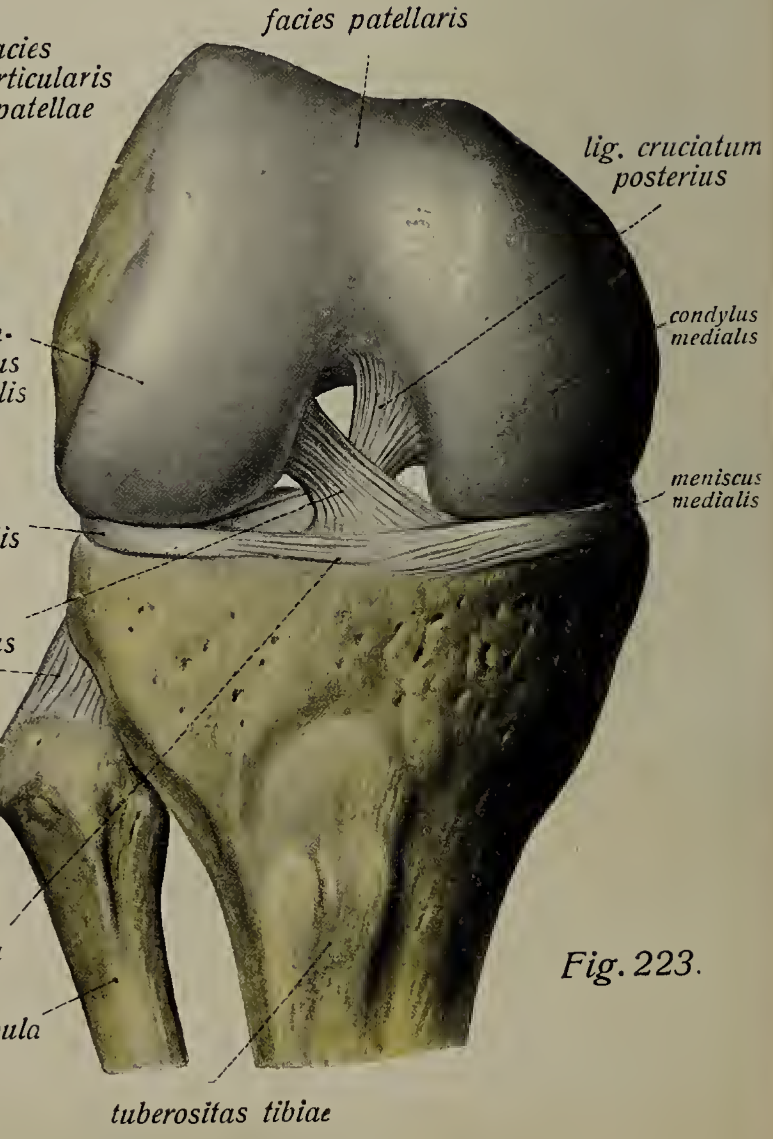


Fig. 223.

The Knee Joint *(articulatio genu).* (Cont.)

Fig. 222. The right knee joint opened by two lateral incisions. The quadriceps and the patella are bent downwards. ($^2/_3$)

Fig. 223. The right knee joint in the flexed position, after removing the capsule and the collateral ligaments. ($^2/_3$)

The synovial folds of the knee joint are the *alar* and *patellar folds.* The former are formed largely of fatty tissue and lie behind the patellar ligaments, where masses of fat covered by the synovial membrane of the joint bulge into the joint cavity forming medial and lateral alar folds. The *patellar fold (ligamentum mucosum)* is a fibrous and usually fat-containing band of variable thickness, that arises between the alar folds and connected with them, from the front wall of the capsule and is attached behind in the intercondyloid fossa.

Of the outpouchings of the joint cavity the largest is the *suprapatellar bursa,* which extends for almost a hand's breadth beneath the tendon of the quadriceps. It is in wide communication with the joint cavity and into its upper wall the fibres of the quadriceps that form the articularis genu muscle are inserted. The posterior wall of the bursa does not rest directly on the femur, but on an interposed fat pad. Two or three much smaller outpouchings of the capsule occur on its posterior wall, the *popliteal* bursa under the tendon of the popliteus, the *semimembranosus bursa* under the tendon of the semimembranosus, and the *medial gastrocnemial bursa* under the tendon of the medial head of the gastrocnemins. The last two may unite. (See Figs. 312 and 313).

Two semilunar cartilages rest on the condyles of the tibia, the *medial* and *lateral menisci.* They are not attached to the condyles, but to the capsule by their outer margins and to the intercondyloid eminence and the cruciate ligaments. In section they are wedge shaped. The *medial meniscus* is smaller than the lateral and almost semicircular; it forms, however, an arc of a greater circle than does the lateral, which is almost circular and open only at its attachment to the intercondyloid eminence. It is broader than the medial and, since its radius is smaller, it covers the condyle of the tibia except over a relatively small central area. The *lateral meniscus* is attached to the anterior intercondyloid fossa and to the lateral intercondyloid tubercle, the medial one extends from the anterior border of the medial condyle of the tibia to the posterior intercondyloid fossa. The two menisci are connected anteriorly by a very variable *transverse ligament.*

The Knee Joint, the Tibio-fibular Articulation, the Interosseous Membrane and the Tibio-fibular Syndesmosis.

Fig. 224. The condyles of the tibia with the two menisci and the origins of the cruciate ligaments. ($^3/_4$)

Fig. 225. Sagittal section of the right knee joint in the region of the lateral condyle. ($^3/_4$)

Fig. 226. The bones of the right lower leg with their connections, from in front. ($^1/_3$)

In addition to the menisci there are associated with the knee joint two remarkably strong ligaments, the *cruciate ligaments*. They arise from the intercondyloid fossa of the femur and pass to the intercondyloid tubercles or fossae of the tibia. The *anterior cruciate ligament* passes between the medial surface of the lateral condyle of the femur and the anterior intercondyloid tubercle and fossa of the tibia, and the *posterior cruciate ligament* arises from the lateral surface of the medial condyle of the femur and passes to the posterior intercondyloid tubercle and fossa of the tibia. The two ligaments, of which the posterior is usually the stronger, cross one another in the extended position of the leg. The posterior one is usually connected with the lateral meniscus.

The *tibio-fibular articulation* is between the fibular articular surface of the femur and the articular surface on the head of the fibula. It is a pronounced amphiarthrosis, with almost flat articular surfaces and with strong connecting bands on its anterior and posterior surfaces, the fibular *capitular ligaments*. Rarely the joint communicates with the knee joint through the popliteal bursa.

The *interosseous membrane* is very similar to that of the forearm and like this, extends between the interosseous crests of the two bones. In its upper part it has a large perforation for the passage of vessels.

The *tibio-fibular syndesmosis* is formed by two ligaments, rich in elastic fibres, extending between the anterior and posterior surfaces of the lower ends of the tibia and fibula. They are the *lateral malleolar ligaments* and are put on the stretch when the broader anterior part of the talus is brought between the two bones.

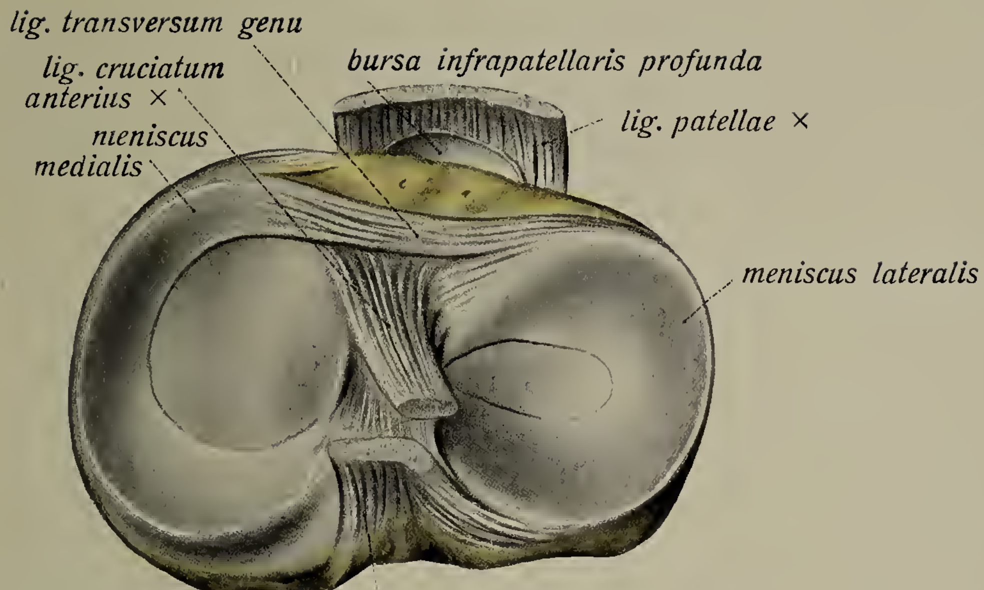

lig. transversum genu
lig. cruciatum anterius ×
meniscus medialis
bursa infrapatellaris profunda
lig. patellae ×
meniscus lateralis
lig. cruciatum posterius ×

Fig. 224.

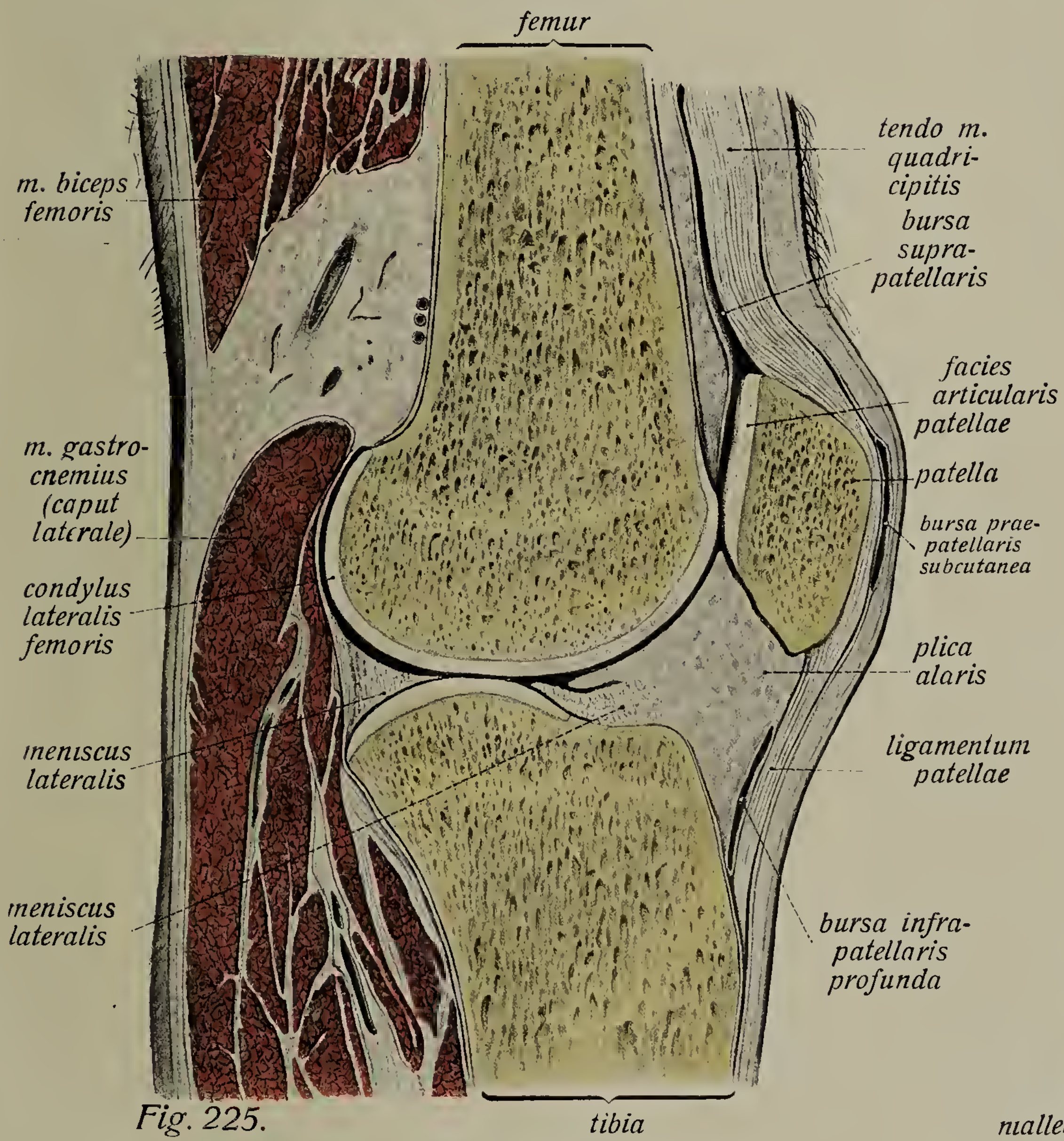

femur
m. biceps femoris
tendo m. quadricipitis
bursa suprapatellaris
facies articularis patellae
m. gastrocnemius (caput laterale)
patella
bursa praepatellaris subcutanea
condylus lateralis femoris
plica alaris
meniscus lateralis
ligamentum patellae
meniscus lateralis
bursa infrapatellaris profunda
tibia

Fig. 225.

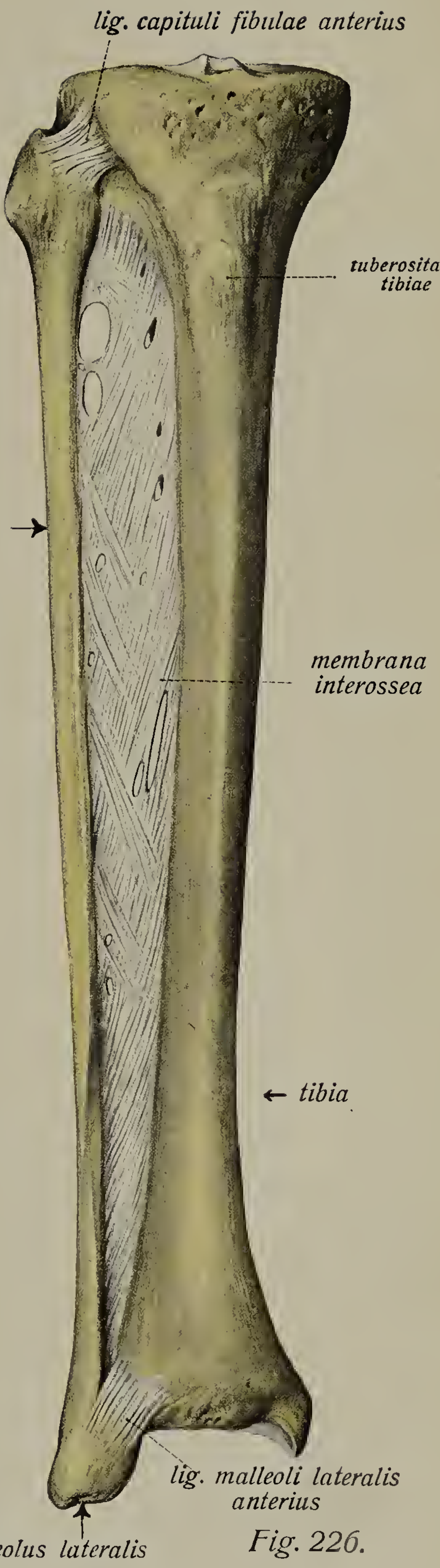


Fig. 226.

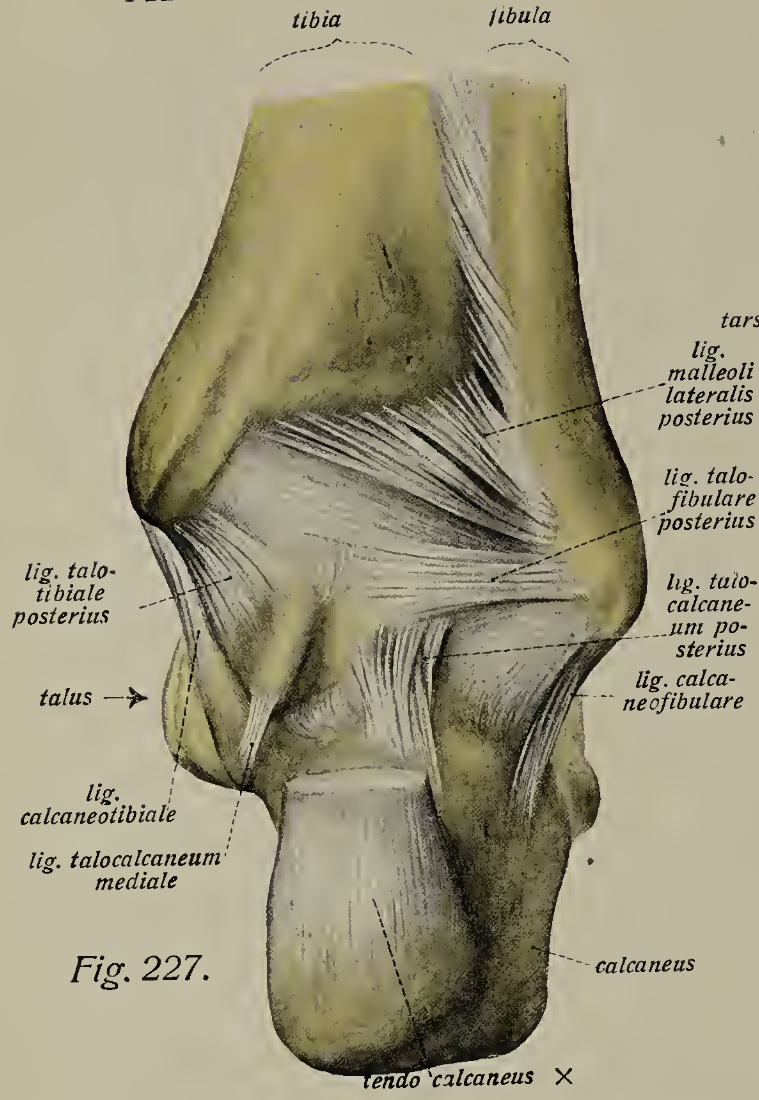

tibia
fibula
lig. malleoli lateralis posterius
lig. talofibulare posterius
lig. talotibiale posterius
lig. talocalcaneum posterius
talus →
lig. calcaneofibulare
lig. calcaneotibiale
lig. talocalcaneum mediale
calcaneus
tendo calcaneus ×

Fig. 227.

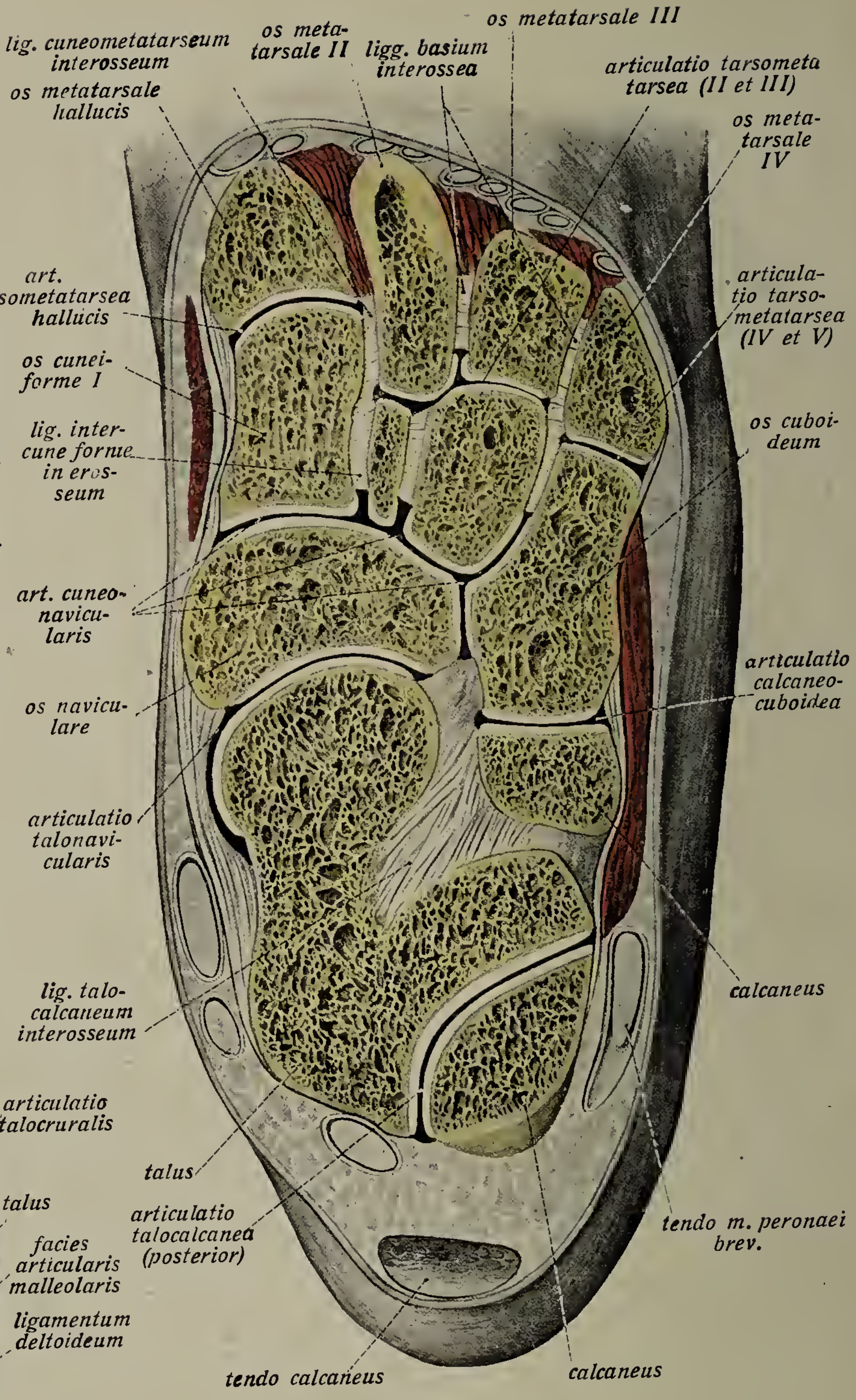

lig. cuneometatarseum interosseum
os metatarsale II
ligg. basium interossea
os metatarsale III
os metatarsale hallucis
articulatio tarsometatarsea (II et III)
os metatarsale IV
art. tarsometatarsea hallucis
articulatio tarsometatarsea (IV et V)
os cuneiforme I
lig. intercuneiforme interosseum
os cuboideum
art. cuneonavicularis
os naviculare
articulatio calcaneocuboidea
articulatio talonavicularis
lig. talocalcaneum interosseum
calcaneus
talus
articulatio talocalcanea (posterior)
tendo m. peronaei brev.
tendo calcaneus
calcaneus

Fig. 228.

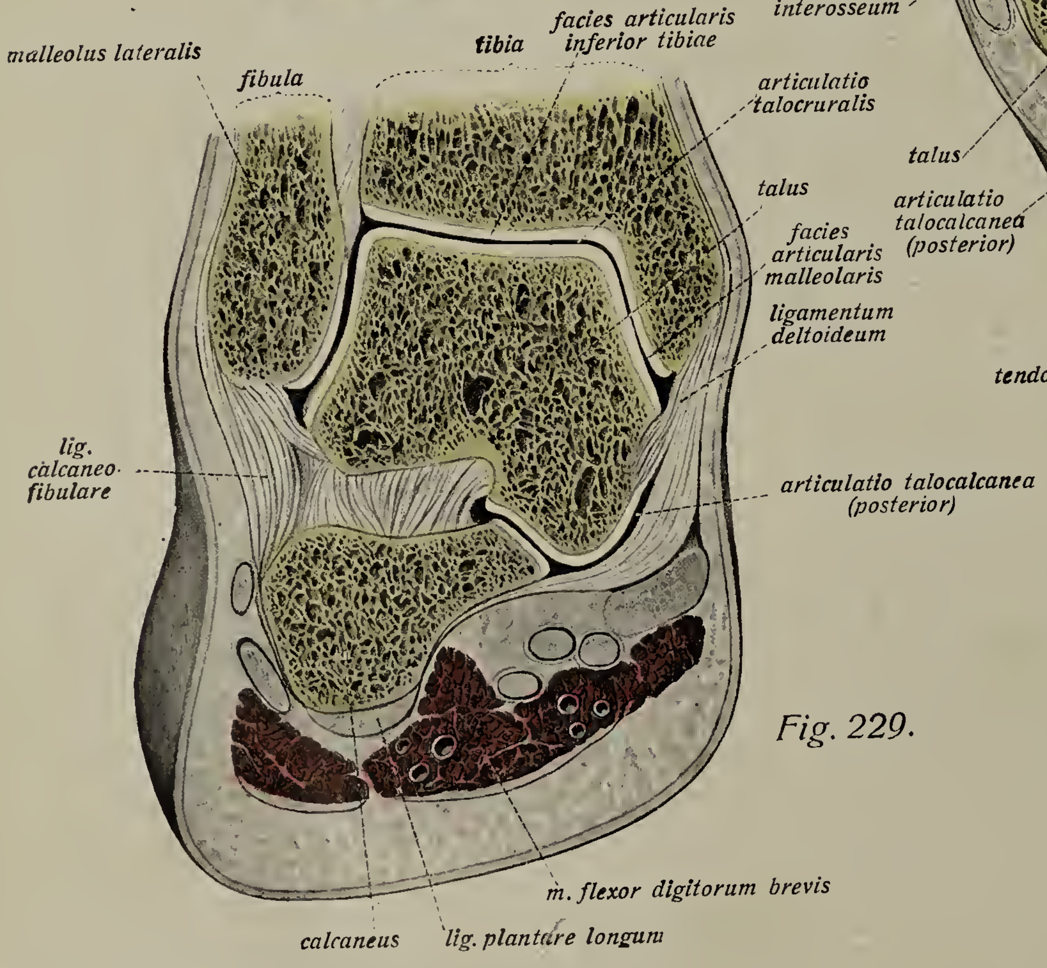


Fig. 229.

The Joints and Ligaments of the Foot.

Fig. 227. The ankle joint from behind. ($^3/_4$)

Fig. 228. Horizontal section through the tarsal joints. ($^3/_4$)

The base of the fifth metatarsal is not cut, on account of the arched form of the foot; the calcaneus is cut twice.

Fig. 229. Frontal section through the ankle and talo-calcaneal joints. ($^3/_4$)

The ankle joint *(talo-crural articulation)* is between the talus and the two bones of the lower leg. The articular surfaces are the trochlea of the talus on the one hand and the inferior surface of the tibia, the articular surface of the medial malleolus and that of the lateral malleolus. The thin *articular capsule* surrounds the articular surfaces.

The group of ligaments that radiate from the medial malleolus to the talus, calcaneus and navicular constitutes what is termed the *deltoid ligament.* It consists of four not very distinctly separate ligaments, the *anterior* and *posterior talo-tibial,* the *calcaneo-tibial* and the *tibio-navicular.* The first of these passes to the anterior part of the neck of the talus and is completely covered in by the calcaneo-tibial. This is attached to the border of the sustentaculum tali,. while the posterior talo-tibial goes to the posterior process of the talus and the tibio-navicular to the dorsal surface of the navicular.

Three distinctly separate ligaments pass from the lateral malleolus to the talus and calcaneus, the *anterior* and *posterior talo-fibular* and the *calcaneo-fibular.* The first of these runs almost horizontally from the anterior surface of the malleolus to the anterior border of the trochlea of the talus; the second, also horizontal, passes to the lateral tubercle of the posterior process of the talus; and the calcaneo-fibular passes obliquely downward and backward to the lateral surface of the calcaneus.

The *talo-calcaneal articulation* is between the posterior articular surface of the calcaneus and the posterior calcaneal facet of the talus. The latter is concave, the former convex. Occasionally the joint cavity communicates with that of the ankle joint.

The *talo-calcaneo-navicular articulation* is between the head of the talus on the one hand and the anterior and middle articular surfaces of the calcaneus, the posterior surface of the navicular and the navicular fibrocartilage in the plantar calcaneo-navicular ligament. The socket for the head of the talus is thus formed by four different cartilage-covered surfaces. It is a combination of the anterior and middle talo-calcaneal and the talo-navicular articulations.

The ligamentous connections of the talus and calcaneus are, firstly, the *interosseous talo-calcaneal ligaments* which fill the sinus tarsi and, secondly, reinforcing ligaments of the posterior talo-calcaneal joint, the *medial, lateral, posterior* and *anterior talo-calcaneal ligaments.* The lateral and anterior ligaments, which bridge over the sinus tarsi, are united with the interosseous ligament, the posterior one extends between the lateral tubercle of the posterior process of the talus and the upper surface of the calcaneus, and the medial passes from the tubercle of the talus to the sustentaculum tali.

The Joints and Articulations of the Foot. (Cont.)

The *calcaneo-cuboid articulation* is between the cuboid surface of the calcaneus and the posterior surface of the cuboid. The surfaces are almost saddle-shaped. With the talo-navicular articulation it formes the *transverse tarsal articulation* (Chopart's).

The *cuneo-navicular articulation* is between the anterior surface of the navicular and the posterior surfaces of the three cuneiform bones and extends between the cuneiform bones themselves, and between the lateral surface of the cuboid and the corresponding surfaces of the navicular and lateral cuneiform. As a rule the joint also communicates between the medial and middle cuneiforms with the second tarso-metatarsal articulation.

The *tarso-metatarsal articulations* (Lisfranc's articulation), together with the intermetatarsal articulations, are three joints, one between the metatarsal of the great toe and the medial cuneiform, a second, between the bases of the second and third metatarsals and the middle and lateral cuneiforms, and a third, between the fourth and fifth metatarsals and the cuboid. The line of the joints is a curve convex anteriorly with a deep backward indentation between the middle cuneiform and the base of the second metatarsal.

The dorsal tarsal ligaments pass from the talus and calcaneus on the one hand to the navicular and cuboid on the other. They are the *dorsal talo-navicular,* the *dorsal calcaneo-navicular* and the *bifurcated ligaments.* The latter unites the anterior medial angle of the calcaneus with the dorsal surfaces of the navicular and cuboid, dividing into two parts corresponding to the two bones.

The *dorsal naviculari-cuneiform ligaments* unite the navicular bone with the cuneiforms ; the *dorsal cuboideo-navicular,* the cuboid with the navicular ; the *dorsal intercuneiform,* the three cuneiforms with one another ; and the *dorsal cuneo-cuboid,* the lateral cuneiform and the cuboid. The *dorsal tarso-metatarsal ligaments* unite the bases of the metatarsals with the tarsal bones and the four *dorsal basal ligaments* unite to one another the bases of the metatarsals.

Fig. 230. The tarsal ligaments, medial surface. $(^3/_4)$

Fig. 231. The tarsal ligaments, dorsal and lateral surfaces. $(^3/_4)$
a = the calcaneo-navicular, b = the calcanec-cuboid portion of the bifurcate ligament.

Fig. 232. The ligaments of the dorsal surface of the foot after cutting away the talus. $(^3/_4)$
The participation of the navicular fibrocartilage in the socket for the head of the talus is shown. * = posterior facet of the navicular bone.

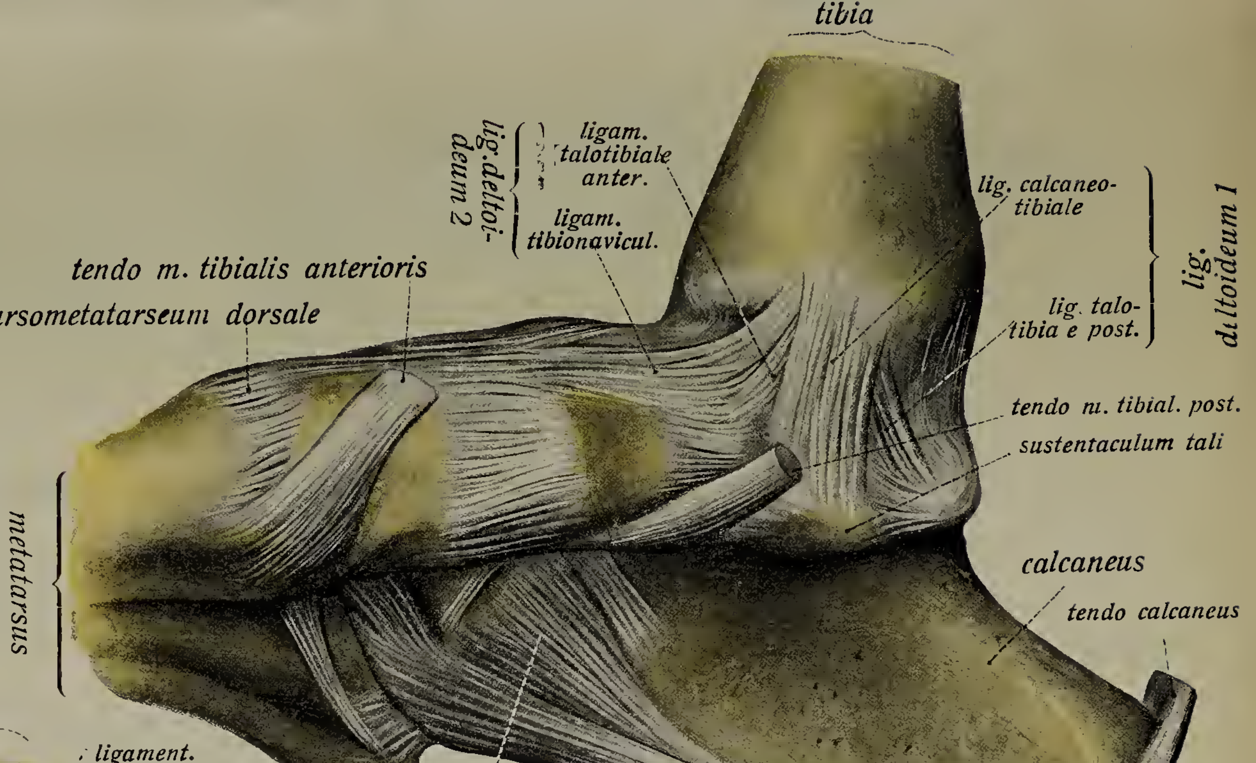


Fig. 230.

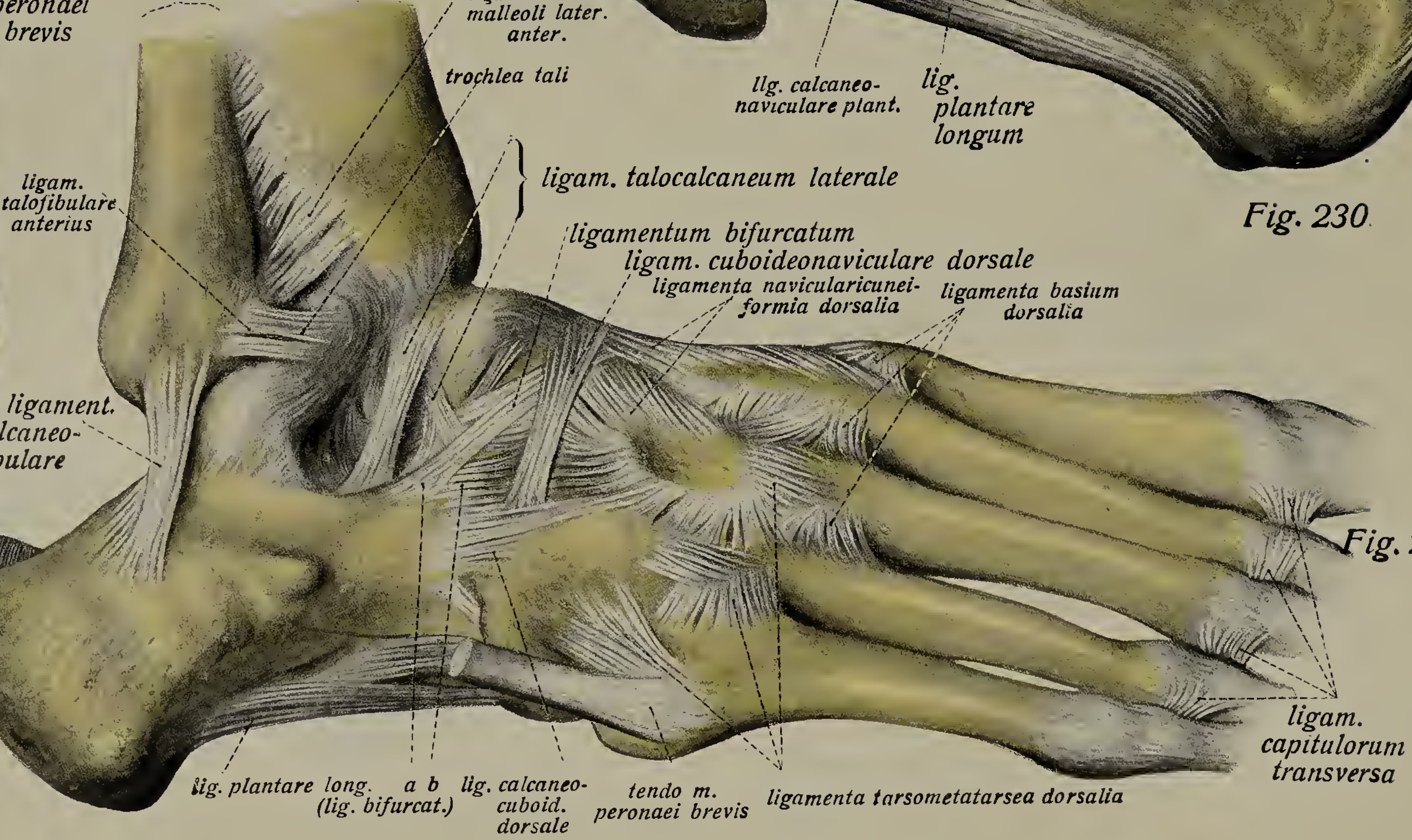

fibula
tibia
ligament. malleoli later. anter.
trochlea tali
ligam. talocalcaneum laterale
ligam. talofibulare anterius
ligamentum bifurcatum
ligam. cuboideonaviculare dorsale
ligamenta navicularicuneiformia dorsalia
ligamenta basium dorsalia
ligament. calcaneo-fibulare
ligam. capitulorum transversa
lig. plantare long.
a b (lig. bifurcat.)
lig. calcaneo-cuboid. dorsale
tendo m. peronaei brevis
ligamenta tarsometatarsea dorsalia

Fig. 231.

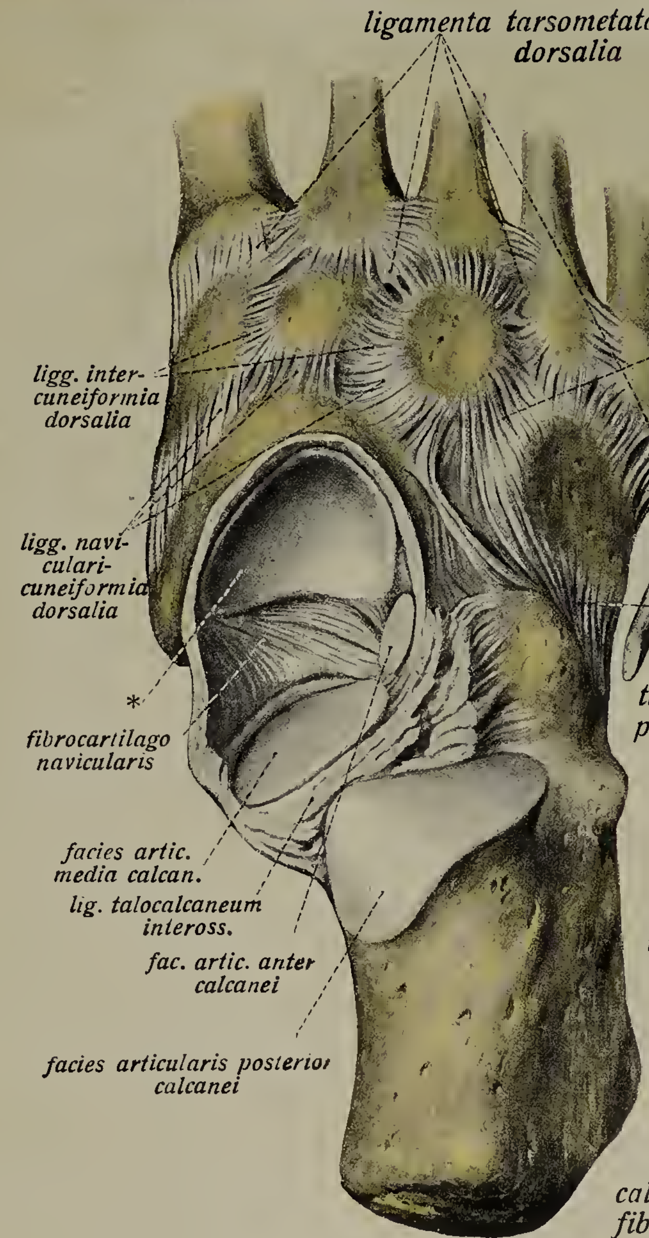

ligamenta tarsometatarsea dorsalia
ligamentum cuneo-cuboideum dorsale
ligg. inter-cuneiformia dorsalia
ligg. navi-culari-cuneiformia dorsalia
ligam. calcaneo-cuboideum dorsale
tendo m. peronaei brevis
*
fibrocartilago navicularis
facies artic. media calcan.
lig. talocalcaneum inteross.
fac. artic. anter calcanei
facies articularis posterior calcanei

Fig. 232.

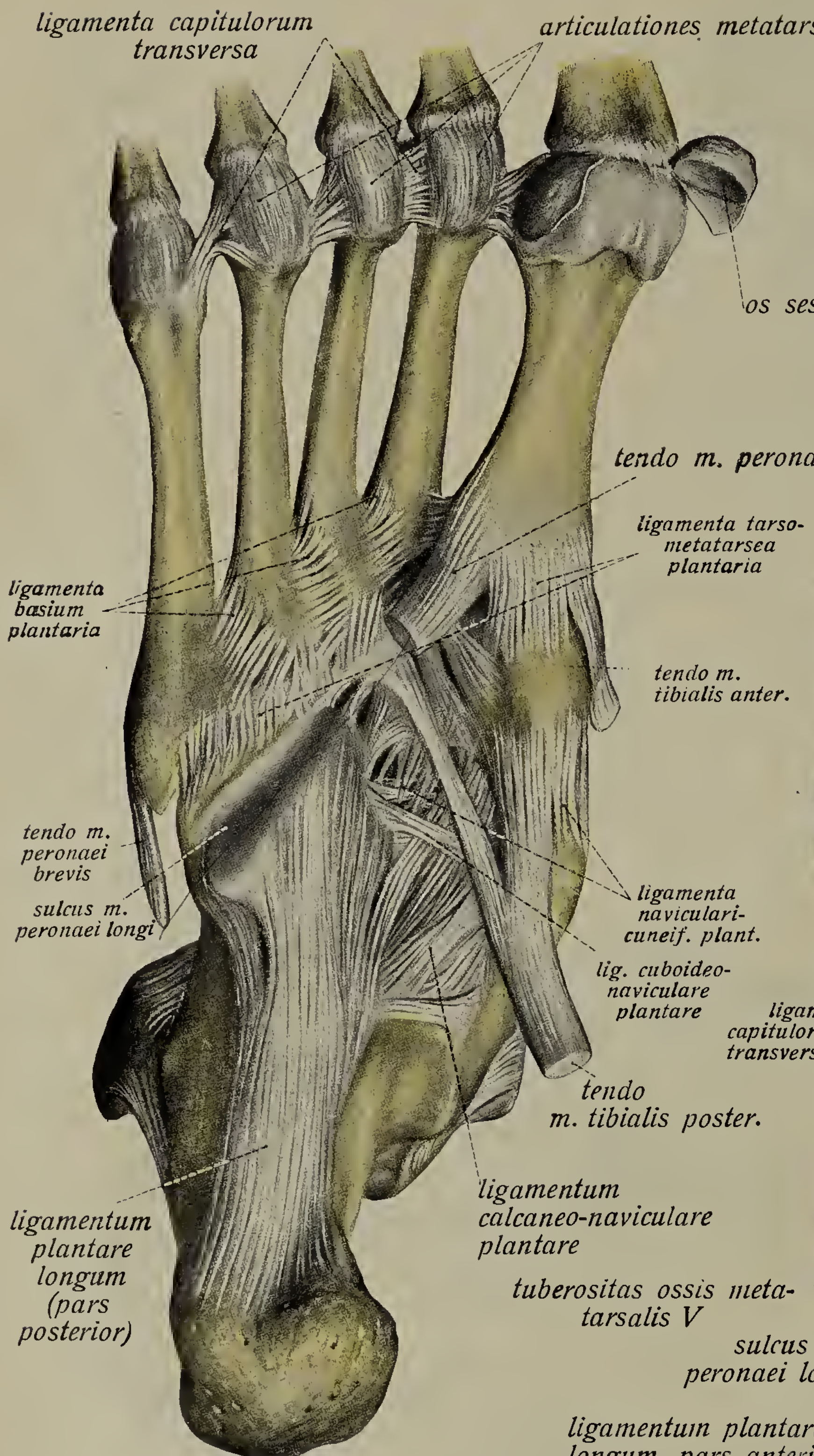

ligamenta capitulorum transversa
articulationes metatarsophalangeae
os sesamoideum
tendo m. peronaei longi ×
ligamenta tarso-metatarsea plantaria
ligamenta basium plantaria
tendo m. tibialis anter.
tendo m. peronaei brevis
sulcus m. peronaei longi
ligamenta naviculari-cuneif. plant.
lig. cuboideo-naviculare plantare
tendo m. tibialis poster.
ligamentum plantare longum (pars posterior)
ligamentum calcaneo-naviculare plantare

Fig. 234.

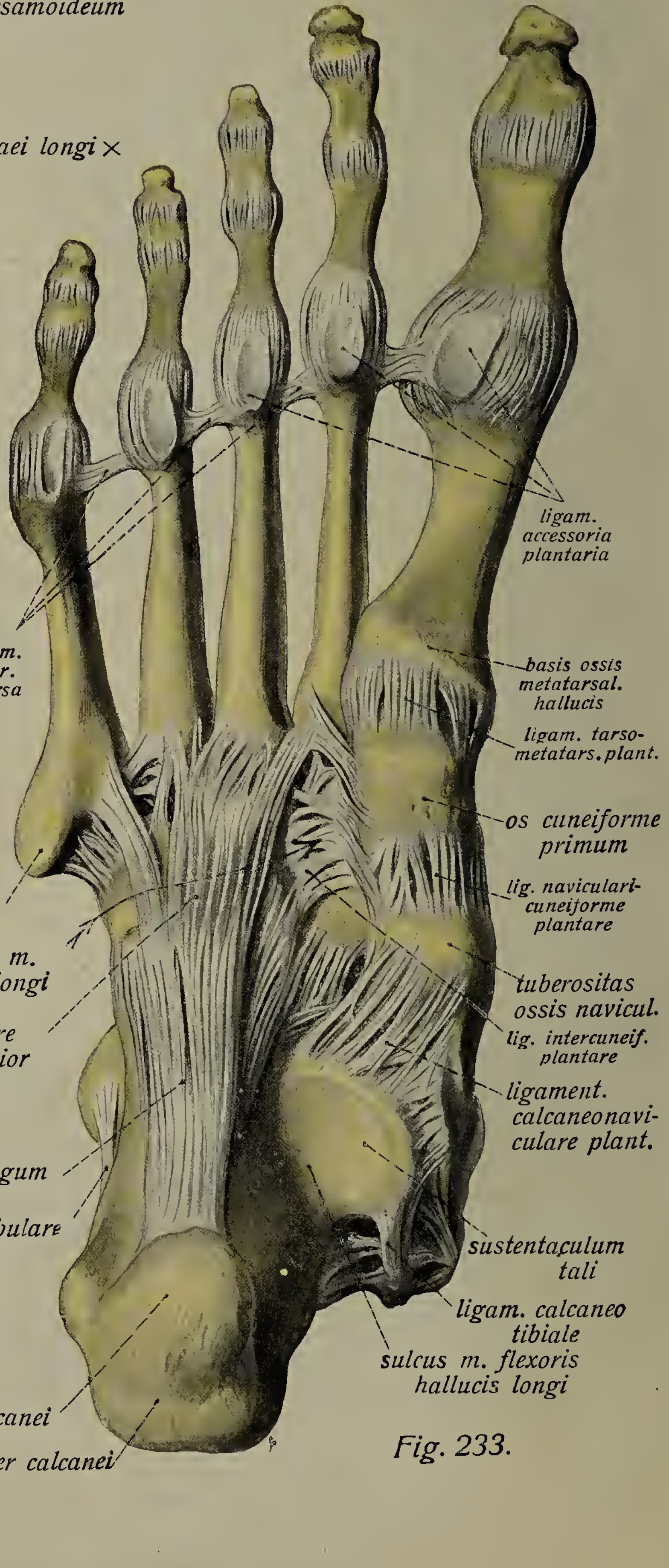

ligam. accessoria plantaria
ligam. capitulor. transversa
basis ossis metatarsal. hallucis
ligam. tarso-metatars. plant.
os cuneiforme primum
lig. naviculari-cuneiforme plantare
tuberositas ossis metatarsalis V
sulcus m. peronaei longi
tuberositas ossis navicul.
lig. intercuneif. plantare
ligamentum plantare longum, pars anterior (retinaculum)
ligament. calcaneonaviculare plant.
ligamentum plantare longum (pars posterior)
ligamentum calcaneofibulare
sustentaculum tali
ligam. calcaneo tibiale
sulcus m. flexoris hallucis longi
processus medialis tuberis calcanei
tuber calcanei

Fig. 233.

The Joints and Ligaments the Foot. (Cont.)

Fig. 233. The superficial layer of the ligaments of the plantar surface of the foot. ($^3/_4$)

Fig. 234. The deep layer of the ligaments of the plantar surface of the foot. ($^3/_4$)
The anterior portion of the long plantar ligament has been removed exposing the groove for the tendon of the peroneus longus. The metatarsal phalangeal joint of the great toe has been opened.

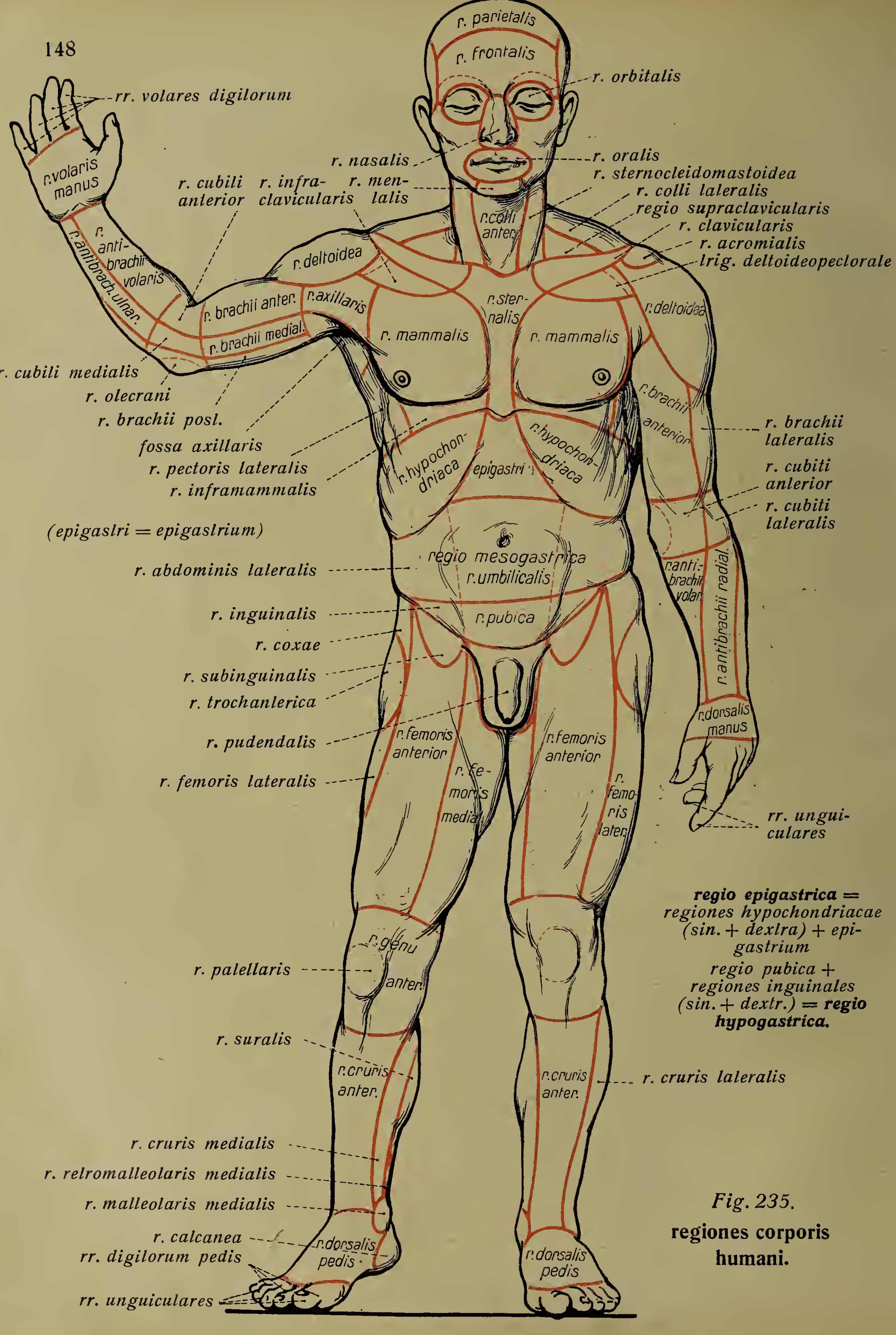
By far the strongest ligament of the sole of the foot is the *long plantar ligament.* It arises from the whole of the under surface of the calcaneus and from the medial and lateral tuberosities of the tuber calcanei, covering the entire width of the bone, and passes with very strong longitudinal fibres to the tuberosity of the cuboid. From this principal portion of the ligament superficial slips pass out, which pass over the tendon sheath of the groove on the cuboid and reach the basis of the lateral metatarsals. They form the retinaculum for the tendon sheath of the peroneus longus.

Almost as strong is the *plantar calcaneo-navicular ligament.* It runs with oblique, very strong fibres between the sustentaculum tali and the navicular. On its dorsal surface it contains the *navicular fibrocartilage,* which forms part of the socket for the head of the talus.

The *plantar naviculari-cuneiform ligaments* unite the navicular and the cuneiforms; the *plantar cuboideo-navicular* the cuboid and the navicular; the *plantar cuneo-cuboid,* the cuboid and the lateral cuneiform; and the *plantar intercuneiform,* the three cuneiforms with one another. In addition, there are *plantar tarso-metatarsal* and three *plantar basal ligaments* which correspond with the dorsal. The *plantar calcaneo-cuboid ligament,* which reinforces the capsule of the calcaneo-cuboid joint, unites with the dorsal surface of the long plantar ligament.

Those ligaments that are on neither the dorsal nor the plantar surfaces, but connect adjacent surfaces of the tarsal and metatarsal bones, are termed interosseous ligaments. In addition to the *interosseous talo-calcaneal ligaments* there is an *interosseous cuneo-cuboid, interosseous intercuneiform, interosseous cuneo-metatarsal,* (especially between the medial cuneiform and the base of the second metatarsal where an interosseous basal ligament is wanting), and *interosseous basal ligaments.*

The *metatarso-phalangeal* and *interphalangeal articulations* of the foot are, with slight differences, similar to those of the hand, and present the same ligaments. The metatarso-phalangeal joint of the great toe shows a special structure in that two large sesamoid bones are imbedded in its capsule on the plantar surface.



(epigastri = epigastrium)

regio epigastrica *= regiones hypochondriacae (sin. + dextra) + epigastrium*

regio pubica + regiones inguinales (sin. + dextr.) = ***regio hypogastrica.***

Fig. 235.

regiones corporis humani.

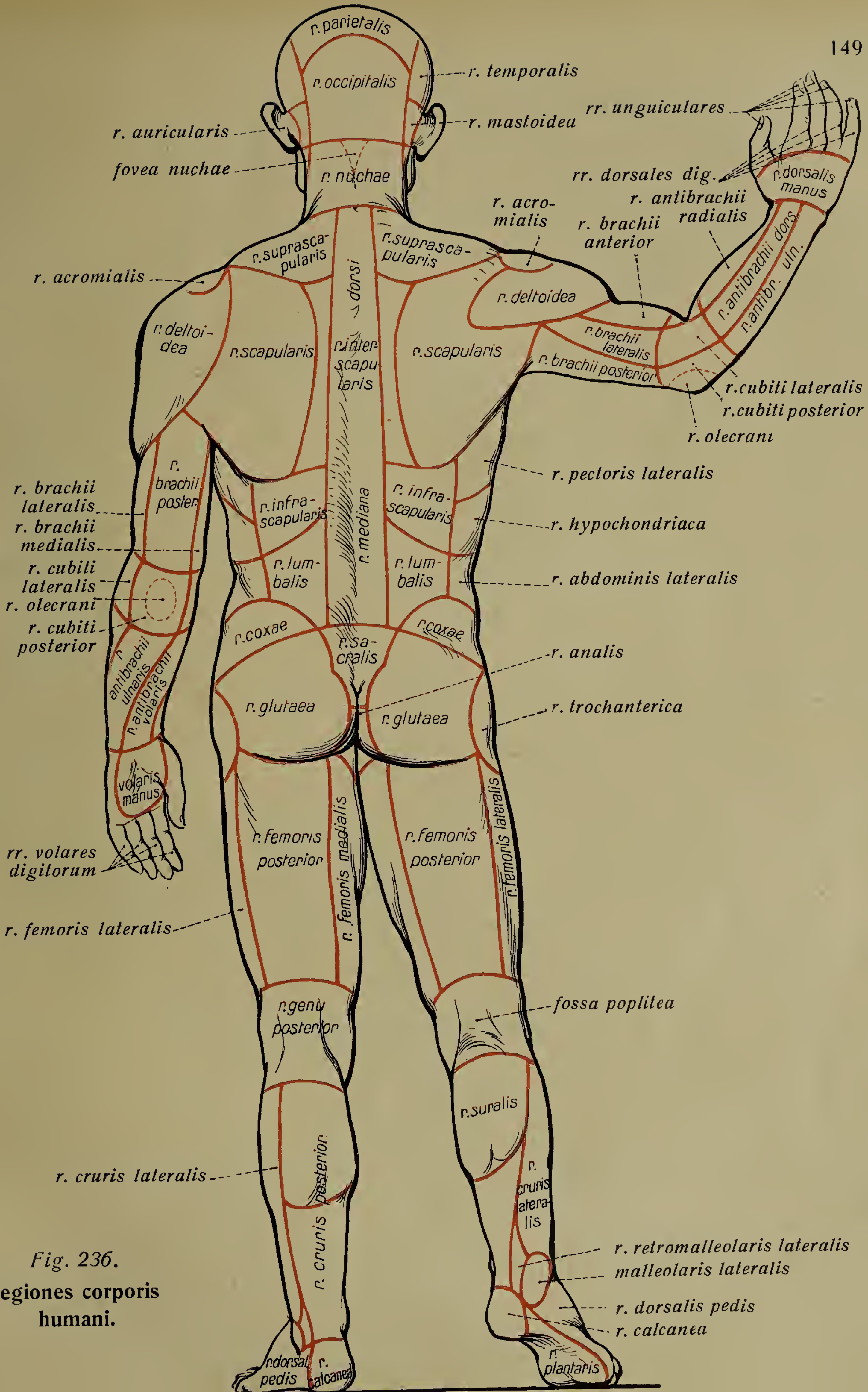


Fig. 236.

regiones corporis humani.

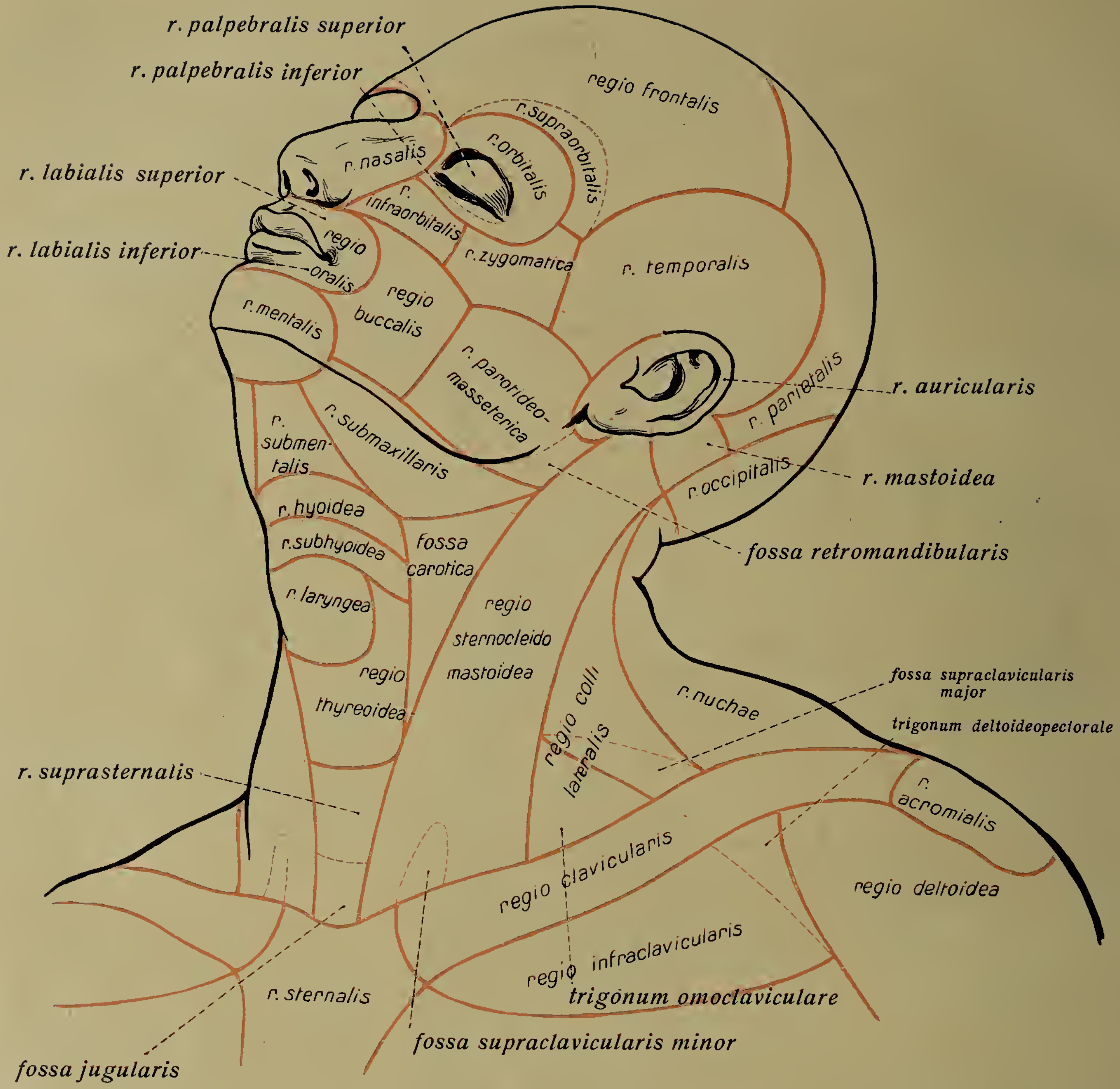


Fig. 237.

regiones capitis et colli.

regiones perineales.

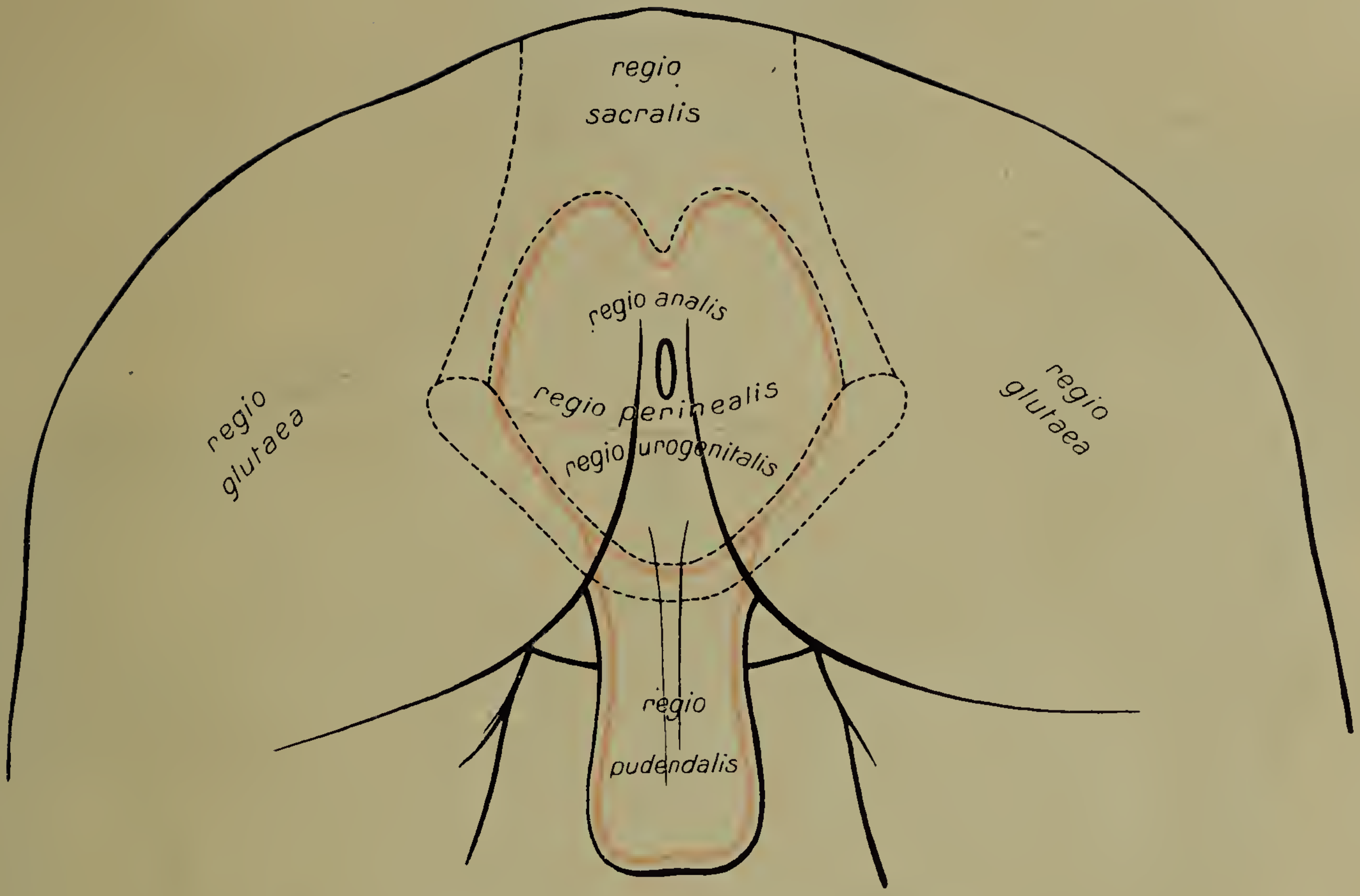


Fig. 238a. The male perineum.

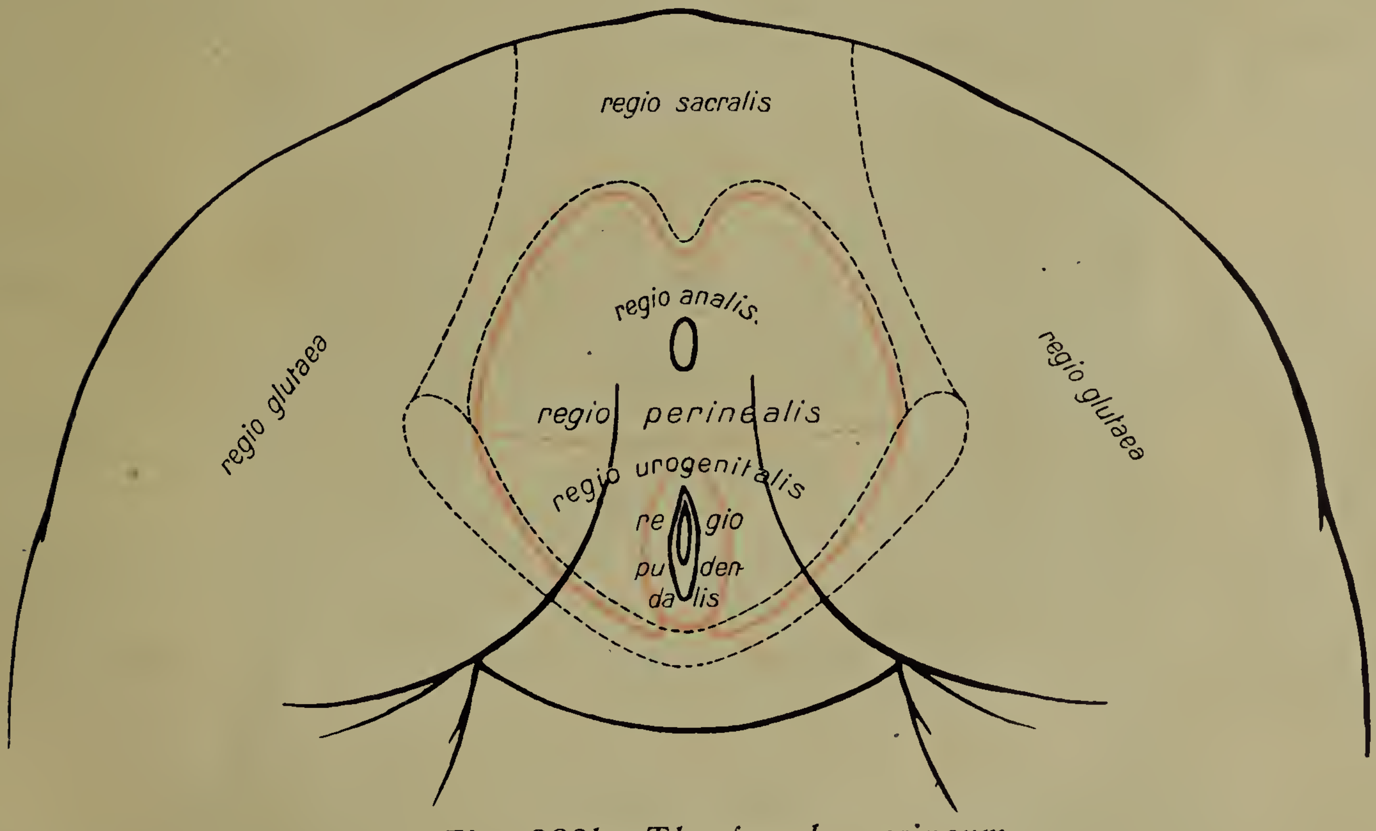


Fig. 238b. The female perineum.

Myology.

The Muscles of the Back.

Fig. 239. The superficial layer of the muscles of the back with the neighboring muscles of the neck and abdomen, from behind.

On the right side the rhomboideus major and teres minor are covered by fascia. $(^1/_3)$
* = origin of the latissimus from the crest of the ilium.
** = costal serration of the latissimus.

---

1. The Flat Muscles of the Back.

First Layer.

The **Trapezius** arises from the squamous portion of the occipital above the superior nuchal line, from the lig. nuchae, and from the spines of the last cervical and all the thoracic vertebrae. It is inserted into the acromial third of the clavicle, the acromion and spine of the scapula. *Nerve:* The spinal accessory and branches of the cervical plexus. *Action:* The upper fibres raise the scapula, the lower depress it; all acting together draw the scapula backward; those to the skull rotate the head toward the opposite side, the lower fibres draw the lower angle of the scapula medialwards.

The **Latissimus dorsi** arises from the spinous processes of the lower six thoracic and all the lumbar vertebrae, from the dorsal surface of the sacrum, and the lateral lip of the iliac crest. Accessory slips arise from the lower three or four ribs and frequently from the lower angle of the scapula. It inserts into the ?? crest of the lesser tuberosity of the humerus, together with the teres major from which it is separated by a bursa. *Nerve:* The thoraco-dorsal from the brachial plexus. *Action:* It draws the arm backward, adducts it and rotates it inward.

Second Layer.

The **Rhomboideus major** arises from the spinous processes of the upper four thoracic vertebrae and inserts into the vertebral border of the scapula, below the spine.

The **Rhomboideus minor** arises from the lig. nuchae and the spinous process of the last cervical vertebra and is inserted into the vertebral border of the scapula, above the spine. *Nerve:* Both rhomboids are supplied by the dorsal scapular from the brachial plexus. *Action:* They draw the scapula towards the vertebral column and upwards.

The **Levator scapulae** arises by four heads from the posterior tubercles of the transverse processes of the four upper cervical vertebrae and inserts into the medial angle of the scapula. *Nerve:* The cervical plexus and the dorsal scapular. *Action:* Draws the medial angle of the scapula upwards and medially.

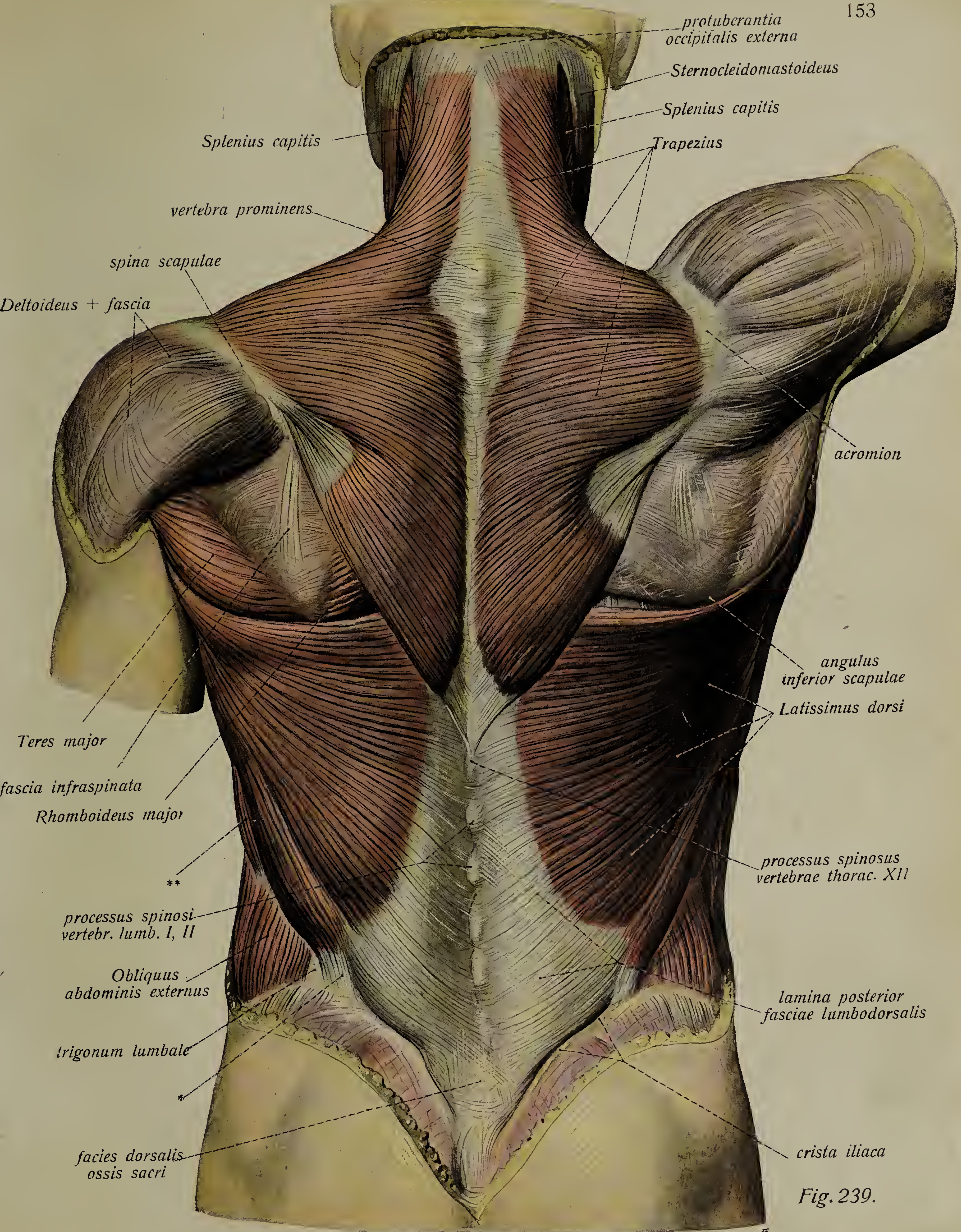

protuberantia occipitalis externa
Sternocleidomastoideus
Splenius capitis
Splenius capitis
Trapezius
vertebra prominens
spina scapulae
Deltoideus + fascia
acromion
angulus inferior scapulae
Latissimus dorsi
Teres major
fascia infraspinata
Rhomboideus major
**
processus spinosus vertebrae thorac. XII
processus spinosi vertebr. lumb. I, II
Obliquus abdominis externus
lamina posterior fasciae lumbodorsalis
trigonum lumbale
*
facies dorsalis ossis sacri
crista iliaca

Fig. 239.

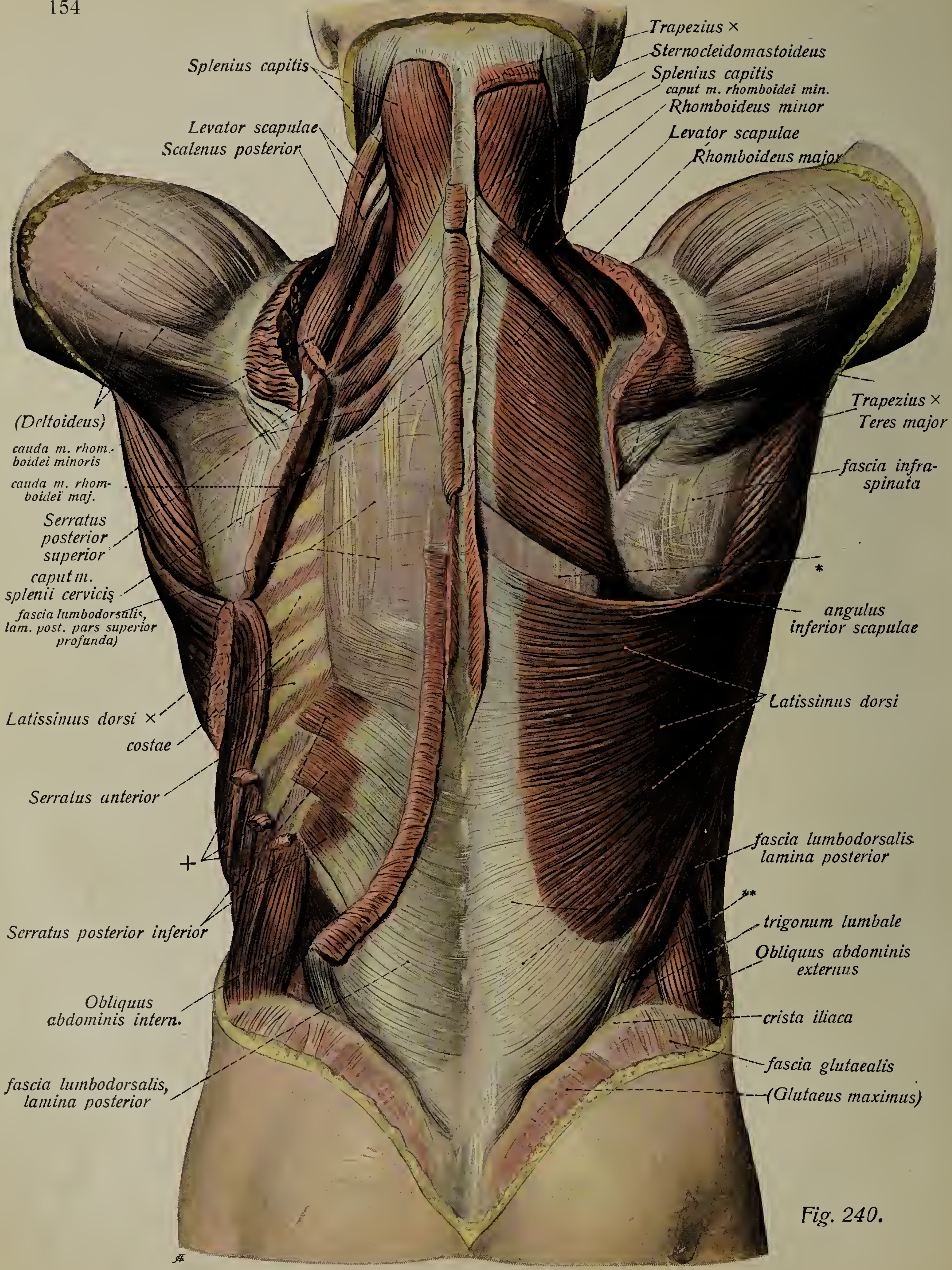

Splenius capitis
Levator scapulae
Scalenus posterior
(Deltoideus)
cauda m. rhomboidei minoris
cauda m. rhomboidei maj.
Serratus posterior superior
caput m. splenii cervicis
fascia lumbodorsalis, lam. post. pars superior profunda)
Latissinus dorsi ×
costae
Serratus anterior
+
Serratus posterior inferior
Obliquus abdominis intern.
fascia lumbodorsalis, lamina posterior
Trapezius ×
Sternocleidomastoideus
Splenius capitis
caput m. rhomboidei min.
Rhomboideus minor
Levator scapulae
Rhomboideus major
Trapezius ×
Teres major
fascia infraspinata
*
angulus inferior scapulae
Latissinus dorsi
fascia lumbodorsalis lamina posterior
**
trigonum lumbale
Obliquus abdominis externus
crista iliaca
fascia glutaealis
(Glutaeus maximus)

Fig. 240.

The Muscles of the Back. (Cont.)

Fig. 240. Deeper layer of the flat muscles of the back. ($^1/_3$)

The trapezius has been removed on both sides; on the left the rhomboids and latissimus are removed and the levator scapulae drawn out to show its origins.
+ = digitation of latissimus. * = sacro-spinalis showing through the fascia. ** = origin of latissimus from the iliac crest.

1. The Flat Muscles of the Back (Cont.)

Third Layer.

The **Superior serratus posterior** arises from the spinous processes of the two lower cervical and the two upper thoracic vertebrae and is inserted into the second to the fifth ribs, lateral to their angles.

The **Inferior serratus posterior** arises, through the posterior layer of the lumbodorsal fascia, from the spinous processes of the lower thoracic and upper lumbar vertebrae. It inserts into the lower borders of the four lower ribs. *Nerve:* Both serrati are supplied by intercostal nerves. *Action:* They act on the ribs in inspiration.

2. The Long Muscles of the Back.

1. The Splenial Muscles.

The **Splenius capitis** arises from the lig. nuchae and the spinous processes of the last cervical and first thoracic vertrebra and inserts into the lateral half of the superior nuchal line, as far out as the mastoid process. *Nerve:* The posterior branches of the 2—4 cervical nerves. *Action:* Both muscles draw the head backwards; acting singly, they rotate the head to the same side.

The **Splenius cervicis** arises from the spinous processes of the third or fourth to the sixth thoracic vertebra and is inserted into the posterior tubercles of the transverse processes of the upper three cervical vertebrae. *Nerve:* The posterior branches of cervical nerves. *Action:* Draws the head backwards and rotates the upper cervical vertebrae and head to the same side.

The Muscles of the Back. (Cont.)

Fig. 241. Superficial layer of the long muscles of the back. ($^1/_3$)
On the right the splenii and sacro-lumbalis are fully exposed; on the left splenii are removed and the sacro-lumbalis separated into its constituent parts. * = cut origins of the latissimus from the ribs.

II. The Sacro-spinalis.

Superficial layer, the **spino-transversalis.**

The **Sacrospinalis** consists of the lateral ilio-costalis and the medial, stronger longissimus. Medial to the latter and fused with it is the spinalis.

The **Iliocostalis** has three parts. The **iliocostalis lumborum** arises with the longissimus dorsi from the dorsal surface of the sacrum and from the lateral lip of the iliac crest. It inserts into the angles of the fifth to the twelfth ribs. The **Iliocostalis dorsi** arises by digitations from the twelfth to the seventh ribs and inserts into the angles of the upper six ribs and the transverse process of the seventh cervical vertebra. The **Iliocostalis cervicis** arises from the upper and middle ribs and inserts into the transverse processes of the middle cervical vertebrae. *Nerve:* Posterior branches of the cervical, thoracic and lumbar nerves. *Action:* Extends the vertebral column and bends it backward, acting with the other long muscles.

The **Longissimus** also consists of three parts. The **Longissimus dorsi** arises with the iliocostalis lumborum from the dorsal surface of the sacrum and from the spinous processes of the lumbar and lower thoracic vertebrae. It inserts into the accessory processes of the upper lumbar and the transverse processes of the thoracic vertebrae, and, more laterally, into the tips of the spinous processes of the lumbar vertebrae and into all the ribs, between their angles and tubercles. The **Longissimus cervicis** arises from the transverse processes of the upper thoracic vertebrae and inserts into the transverse processes of the upper and middle cervicals. The **Longissimus capitis (Trachelomastoid)** arises from the transverse processes of the upper thoracic vertebrae and from the transverse and articular processes of the middle and lower cervicals. It is inserted into the posterior border of the mastoid process. *Nerve:* Posterior rami of the cervical and thoracic nerves. *Action:* Extends the vertebral column and bends it backwards.

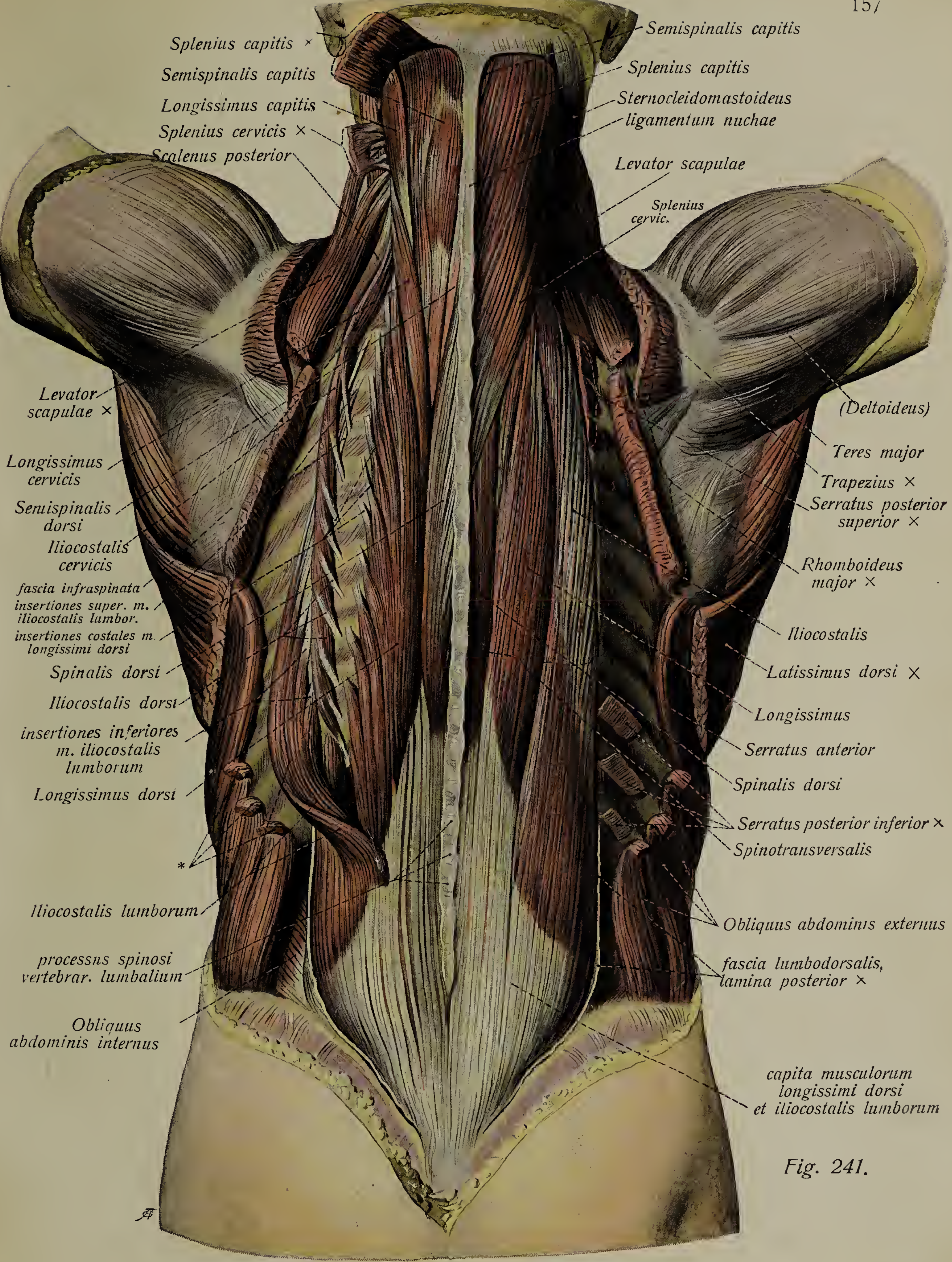

Splenius capitis ×
Semispinalis capitis
Longissimus capitis
Splenius cervicis ×
Scalenus posterior
Levator scapulae ×
Longissimus cervicis
Semispinalis dorsi
Iliocostalis cervicis
fascia infraspinata
insertiones super. m. iliocostalis lumbor.
insertiones costales m. longissimi dorsi
Spinalis dorsi
Iliocostalis dorsi
insertiones inferiores m. iliocostalis lumborum
Longissimus dorsi
*
Iliocostalis lumborum
processus spinosi vertebrar. lumbalium
Obliquus abdominis internus
Semispinalis capitis
Splenius capitis
Sternocleidomastoideus
ligamentum nuchae
Levator scapulae
Splenius cervic.
(Deltoideus)
Teres major
Trapezius ×
Serratus posterior superior ×
Rhomboideus major ×
Iliocostalis
Latissimus dorsi ×
Longissimus
Serratus anterior
Spinalis dorsi
Serratus posterior inferior ×
Spinotransversalis
Obliquus abdominis externus
fascia lumbodorsalis, lamina posterior ×
capita musculorum longissimi dorsi et iliocostalis lumborum

Fig. 241.

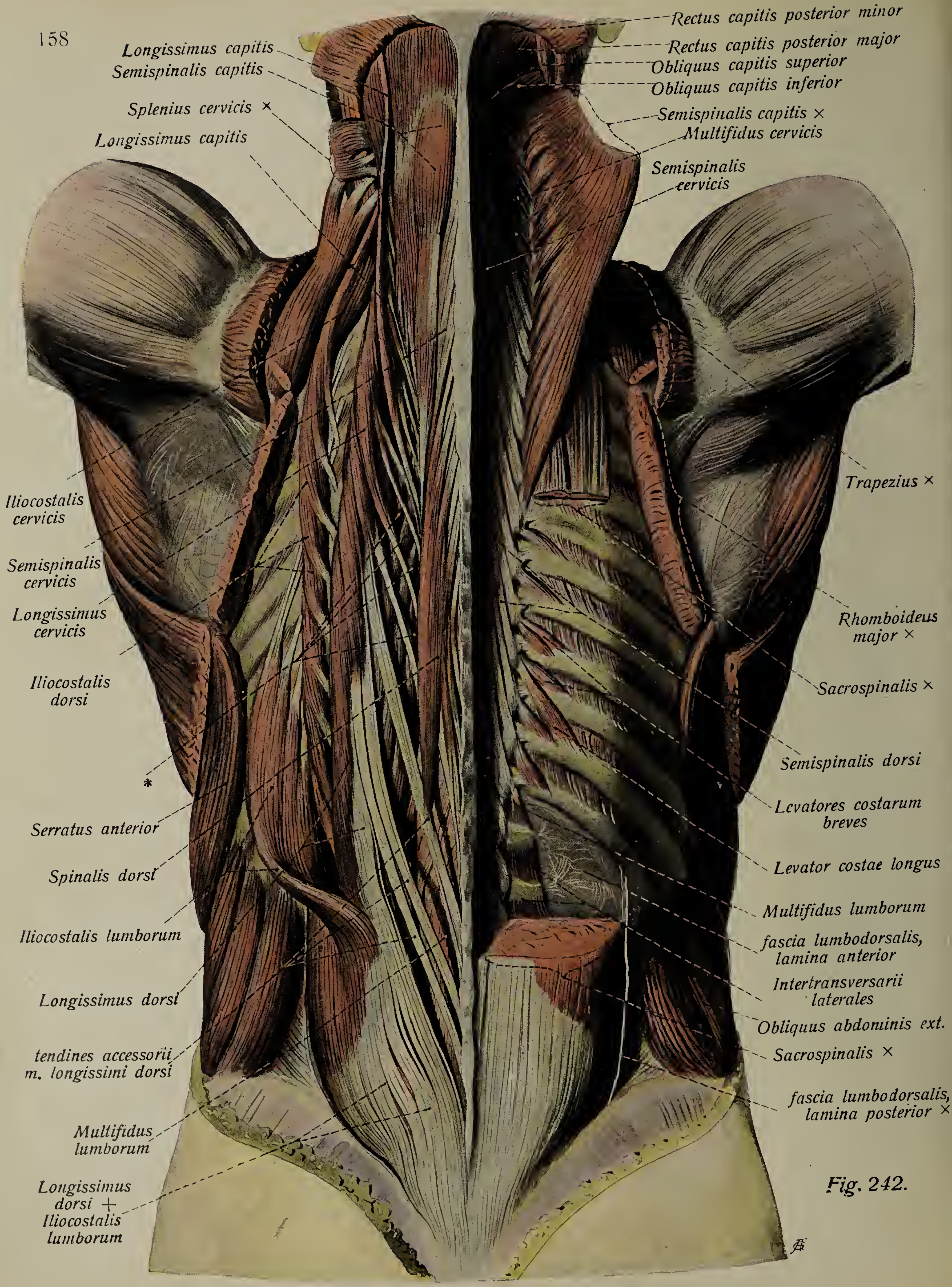

Longissimus capitis
Semispinalis capitis
Splenius cervicis ×
Longissimus capitis
Iliocostalis cervicis
Semispinalis cervicis
Longissimus cervicis
Iliocostalis dorsi
*
Serratus anterior
Spinalis dorsi
Iliocostalis lumborum
Longissimus dorsi
tendines accessorii m. longissimi dorsi
Multifidus lumborum
Longissimus dorsi + Iliocostalis lumborum
Rectus capitis posterior minor
Rectus capitis posterior major
Obliquus capitis superior
Obliquus capitis inferior
Semispinalis capitis ×
Multifidus cervicis
Semispinalis cervicis
Trapezius ×
Rhomboideus major ×
Sacrospinalis ×
Semispinalis dorsi
Levatores costarum breves
Levator costae longus
Multifidus lumborum
fascia lumbodorsalis, lamina anterior
Intertransversarii laterales
Obliquus abdominis ext.
Sacrospinalis ×
fascia lumbodorsalis, lamina posterior ×

Fig. 242.

The Muscles of the Back. (Cont.)

Fig. 242. The deeper layer of the long muscles of the back. ($^1/_3$)
On the left the iliocostalis, longissimus and spinalis are dissected out. On the right the sacro-spinalis is divided in the lumbar region and the semi-spinalis capitis reflected to show the semispinalis dorsi and cervicis. * = medial digitations of the longissimus.

The Fasciae of the Back.

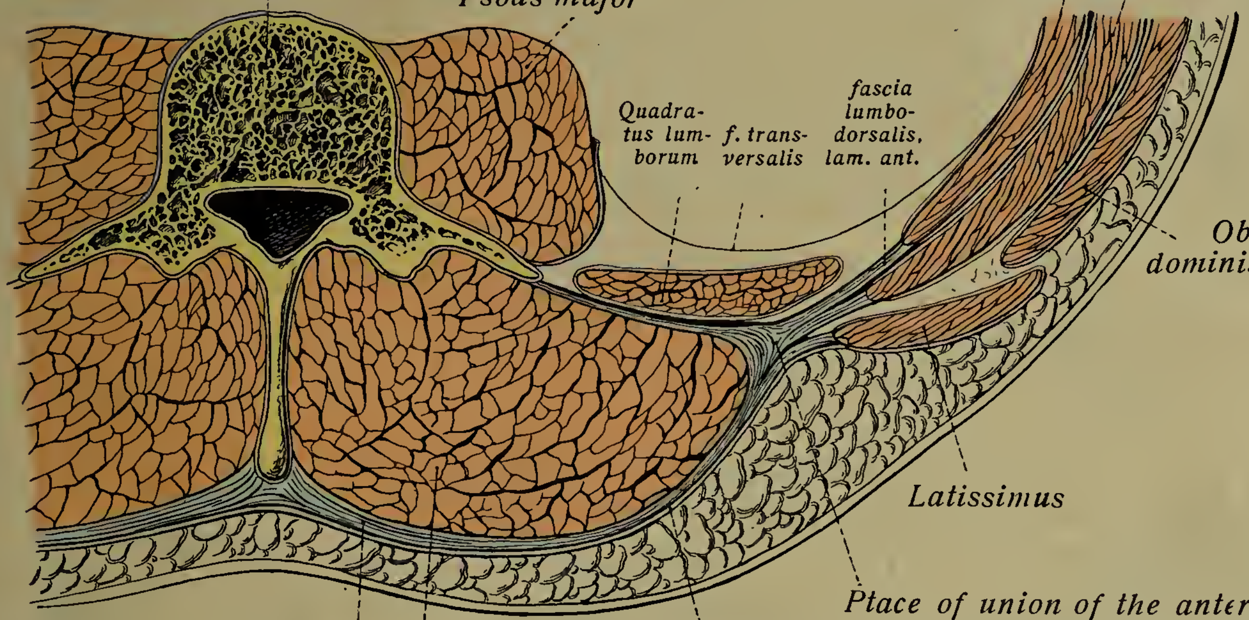

vertebra lumbalis
Psoas major
Transversus abdominis
Obliquus abdominis internus
Quadratus lumborum
f. transversalis
fascia lumbodorsalis, lam. ant.
Obliquus abdominis externus
Latissimus
Place of union of the anterior and posterior part of the fascia
fascia lumbodorsalis (lamina posterior)
Long muscles of the back
fascia lumbodorsalis, lamina posterior

Fig. 243. Transverse section of the back and posterior abdominal wall in the lumbar region, to show the lumbo-dorsal fascia (schematic).

The Superficial Long Muscles of the Back (Spinotransversalis). (Cont.)

The **Spinalis** again has three portions. The **Spinalis dorsi** arises from the spinous processes of the upper lumbar and lower thoracic and inserts into the same processes of the middle and upper thoracic vertebrae. The **Spinalis cervicis** (inconstant) passes between the spinous processes of the lower cervical vertebrae and those of the upper thoracic. The **Spinalis capitis** is properly a portion of the semispinalis capitis, representing its inconstant spinal head. *Nerve:* Posterior rami of the cervical, thoracic and lumbar nerves. *Action:* Bends the vertebral column sidewise.

The Deep Layer, the Transverso-spinalis.

The **Semispinalis** has three portions. The **Semispinalis dorsi** and **cervicis** arise from the transverse processes of the thoracic and lower cervical vertebrae and, passing steeply upward and inward, insert into the spinous processes of the middle and upper thoracic and lower cervical vertebrae. The lateral portion of the **Semispinalis capitis** arises from the transverse processes of the third cervical to the fifth or sixth thoracic vertebrae, the medial portion (the *spinalis capitis)* from the spinous process of the upper thoracic and lower cervical vertebrae. Its insertion is into the squamous portion of the occipital, between the superior and inferior nuchal lines. *Nerves:* Posterior rami of the cervical and thoracic nerves. *Action:* Extends the vertebral column and head. Acting on one side only it rotates the head toward the opposite side.

The Long Muscles of the Back. (Cont.)

The **Multifidus** is a series of small muscles that arise from the dorsal surface of the sacrum and the transverse processes of all the vertebrae up to the lower cervical and pass upwards and inwards to the second or third spinous process next above.

The **Rotatores longi** and **breves** pass between the bases of the transverse processes of the thoracic vertebrae and the spinous process of the vertebra next **(breves)**, or next but one **(longi)**, above. *Nerve:* The Multifidus and Rotatores are supplied by the posterior rami of the spinal nerves. *Action:* Extension of the spinal column and rotation to the opposite side.

III. The Short Muscles of the Back. 1. The Suboccipital Muscles.

The **Rectus capitis posterior major** arises from the spinous process of the axis (epistropheus) and is inserted into the inferior nuchal line.

The **Rectus capitis posterior minor** arises from the posterior tubercle of the atlas and ascends to the inferior nuchal line. The **Rectus capitis lateralis** (see Fig. 263) takes its origin from the transverse process of the atlas and passes to the jugular process of the occipital.

The **Obliquus capitis superior** arises from the transverse process of the atlas and passes upwards to the inferior nuchal line. The **Obliquus capitis inferior** arises from the spinous process of the axis (epistropheus) and passes outwards and upwards to the transverse process of the atlas.

Nerve: All five muscles are supplied by the suboccipital nerve, the posterior ramus of the first cervical. *Action:* They serve for the extension and rotation of the head. The obliquus inferior and rectus major rotate toward the same side, the obliquus superior to the opposite one.

Fig. 244. The middle and deep layers of the muscles of the back of the neck, from behind. ($^2/_3$)
On the left the splenius capitis has been cut and reflected; on the right the semispinalis capitis also.

Fig. 245. The middle layer of the muscles of the back of the neck, from the left side. ($^2/_3$)
The splenii are cut and reflected.

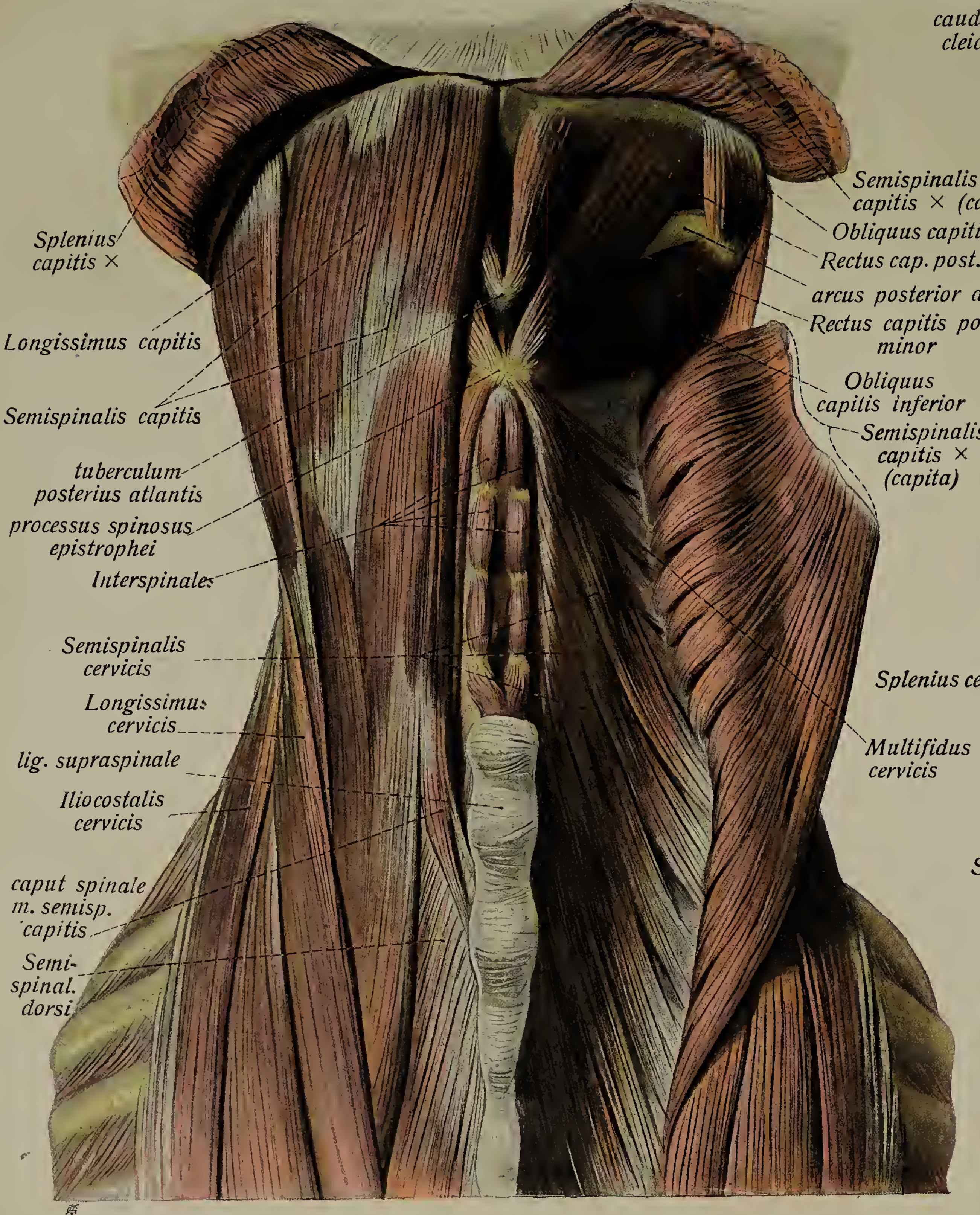

Splenius capitis ×
Longissimus capitis
Semispinalis capitis
tuberculum posterius atlantis
processus spinosus epistrophei
Interspinales
Semispinalis cervicis
Longissimus cervicis
lig. supraspinale
Iliocostalis cervicis
caput spinale m. semisp. capitis
Semispinal. dorsi
Semispinalis capitis × (cauda)
Obliquus capitis superior
Rectus cap. post. major
arcus posterior atlantis
Rectus capitis posterior minor
Obliquus capitis inferior
Semispinalis capitis × (capita)
Multifidus cervicis

Fig. 244.

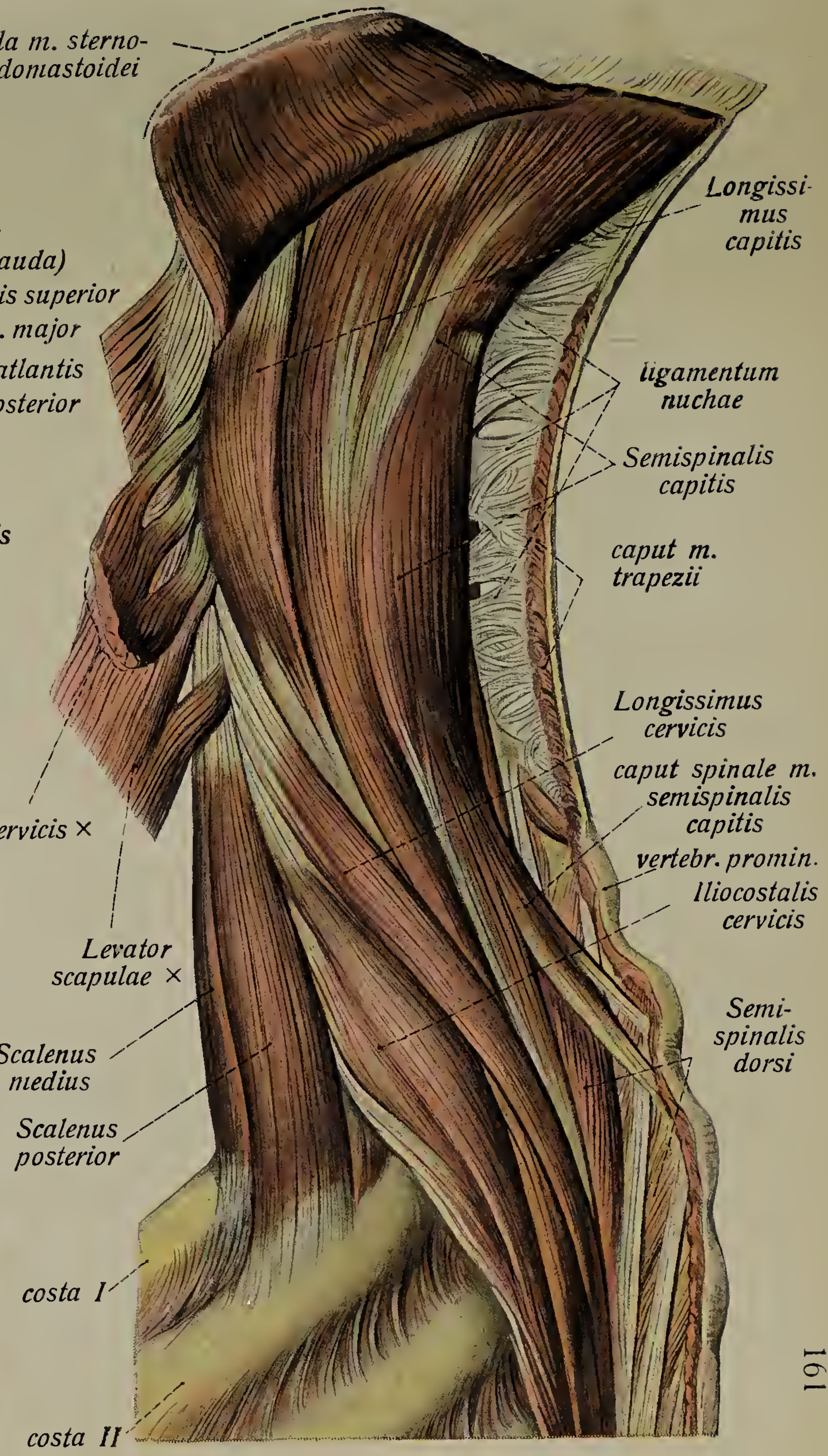


Fig. 245.

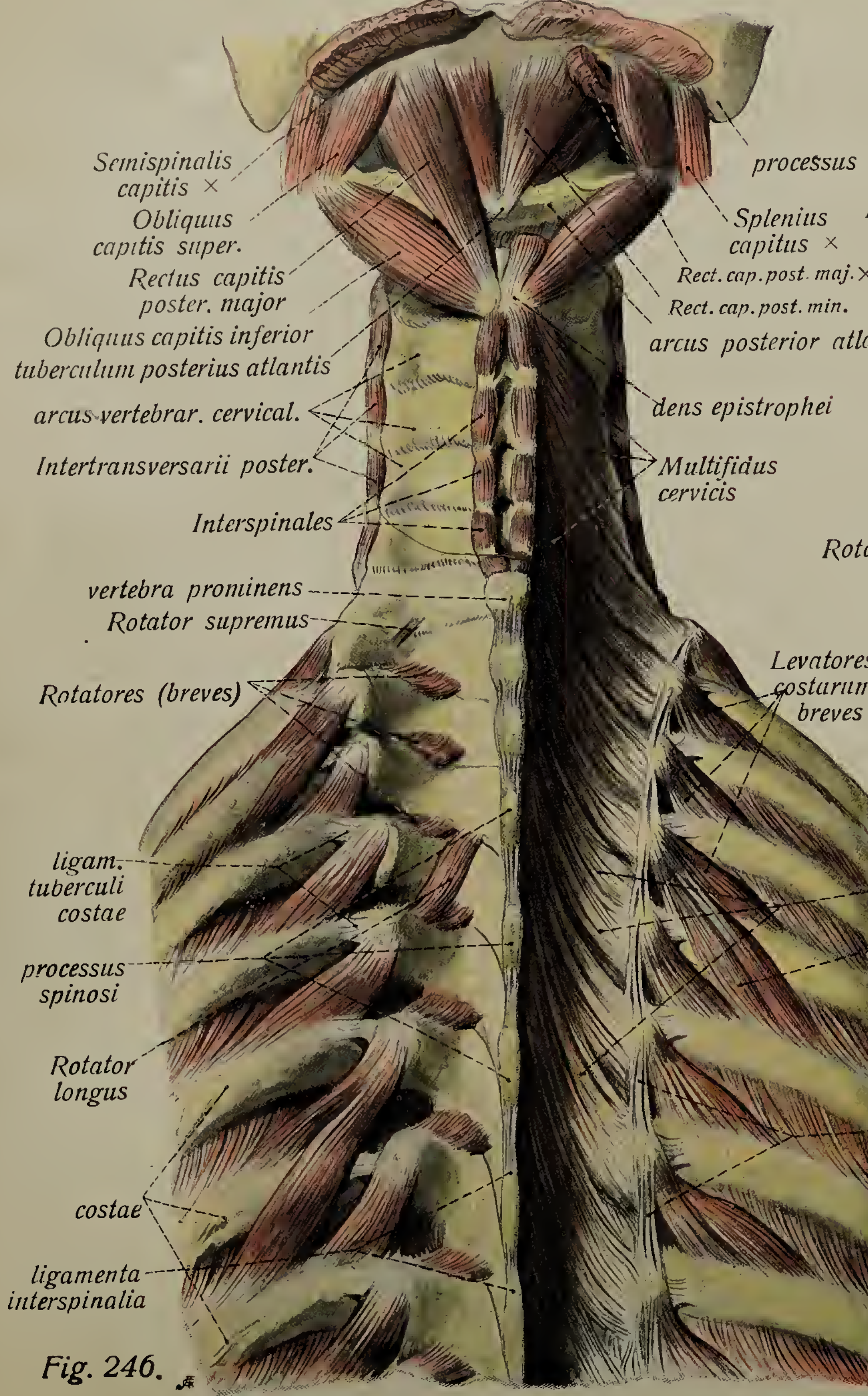


Fig. 246.

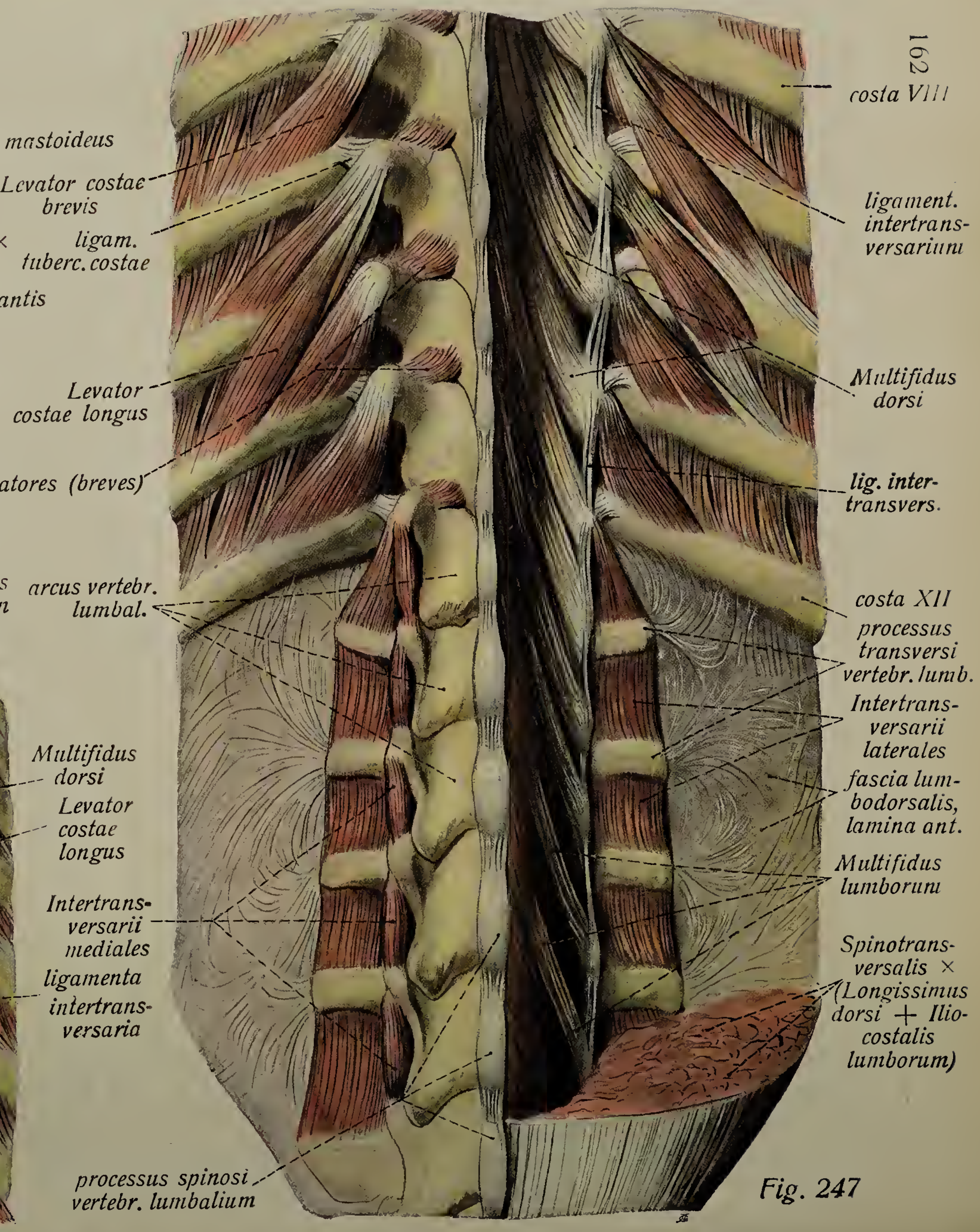

Levator costae brevis
ligam. tuberc. costae
Levator costae longus
Rotatores (breves)
arcus vertebr. lumbal.
Intertransversarii mediales
processus spinosi vertebr. lumbalium
costa VIII
ligament. intertransversarium
Multifidus dorsi
lig. intertransvers.
costa XII
processus transversi vertebr. lumb.
Intertransversarii laterales
fascia lumbodorsalis, lamina ant.
Multifidus lumborum
Spinotransversalis × (Longissimus dorsi + Iliocostalis lumborum)

Fig. 247

The Short Muscles of the Back. (Cont.)

2. The Interspinales and Intertransversarii.

The **Interspinales** are wanting in the thoracic region. Elsewhere they extend from spinous process to spinous process. The first are between the atlas and axis (epistropheus), and throughout the cervical region they are paired, the spinous processes being bifurcated.

The **Intertransversarii** are, as a rule, absent in the thoracic region. In the cervical there are **Anterior intertransversarii,** between the anterior tubercles of successive vertebrae, and **Posterior intertransversarii** between successive transverse tubercles. In the lumbar region there are **Medial intertransversarii,** between the accessory and mamillary processes of succeeding vertebrae, and **Lateral intertransversarii** between the transverse processes; the latter are much the larger.

Nerves: posterior rami of the spinal nerves. *Action:* The interspinales bend the spinal column backwards, the intertransversarii bend it laterally.

The **Levatores costarum** are really the posterior portions of the intercostal muscles. They arise from the transverse processes of the thoracic vertebrae and pass to the succeeding rib *(Levatores costarum breves),* or to the next but one *(Levatores costarum longi)* inserting between the tuberosity and the angle. *Nerves:* The intercostal. *Action:* Raise the ribs, extend the vertebral column and bend it laterally.

The Fasciae of the Back.

The strongest fascia of the back is the **lumbo-dorsal fascia** whose relations are shown in Fig. 243. The superficial layer of muscles is covered by the general fascia, but the different layers of the long muscles are not distinctly separated by fascia and the short muscles are destitute of it.

The Muscles of the Back. (Cont.)

Fig. 246. The deep layer of the muscles of the back, upper half. (${}^{3}/_{4}$)
On the left the muscles are cut away to expose the deep layer; on the right the multifidus is retained, but the rectus capitis major is removed.

Fig. 247. The deep layer of the muscles of the back, lower half. (${}^{3}/_{4}$)
On the left only the deepest muscles are shown; on the right the multifidus is retained.

The Pectoral Muscles.

Fig. 248. The superficial layer of the pectoral and abdominal muscles, from in front and from the right. (${}^2/_3$)

The **Pectoralis major** arises by a *clavicular portion* from the sternal half of the clavicle and by a *sterno-costal portion* from the anterior surface of the manubrium and body of the sternum and from the second to the sixth costal cartilages. It is inserted by a broad tendon, resembling a two-layered pouch with the opening upward, into the crest of the great tuberosity of the humerus. *Nerve:* The anterior thoracic. *Action:* Adducts the arm, draws it medially and forward, rotates it inwards.

The **Pectoralis minor** arises from the second to the fifth ribs, near the cartilages, and inserts into the apex of the coracoid process of the scapula. *Nerve:* The anterior thoracic. *Action:* Draws the scapula downwards; if the scapula is fixed it raises the ribs.

The **Subclavius** is a small muscle arising from the first costal cartilage and inserting into the under surface of the acromial end of the clavicle. *Nerve:* The subclavian from the brachial plexus. *Action:* Fixes the clavicle in the sterno-clavicular joint, drawing it forward and downward.

The **Serratus anterior** arises by digitations from the first to the ninth ribs. The upper portion, from the first and second ribs, is inserted into the medial angle of the scapula; the middle portion, from the second and third ribs, into almost the entire length of the vertebral border of the scapula; the lower portion, from the fourth to the ninth rib, converges on the inferior angle of the scapula. *Nerve:* The long thoracic from the brachial plexus. *Action:* Draws the scapula forward and laterally, especially its lower angle, the scapula thus being rotated on the chest wall, as in raising the arm.

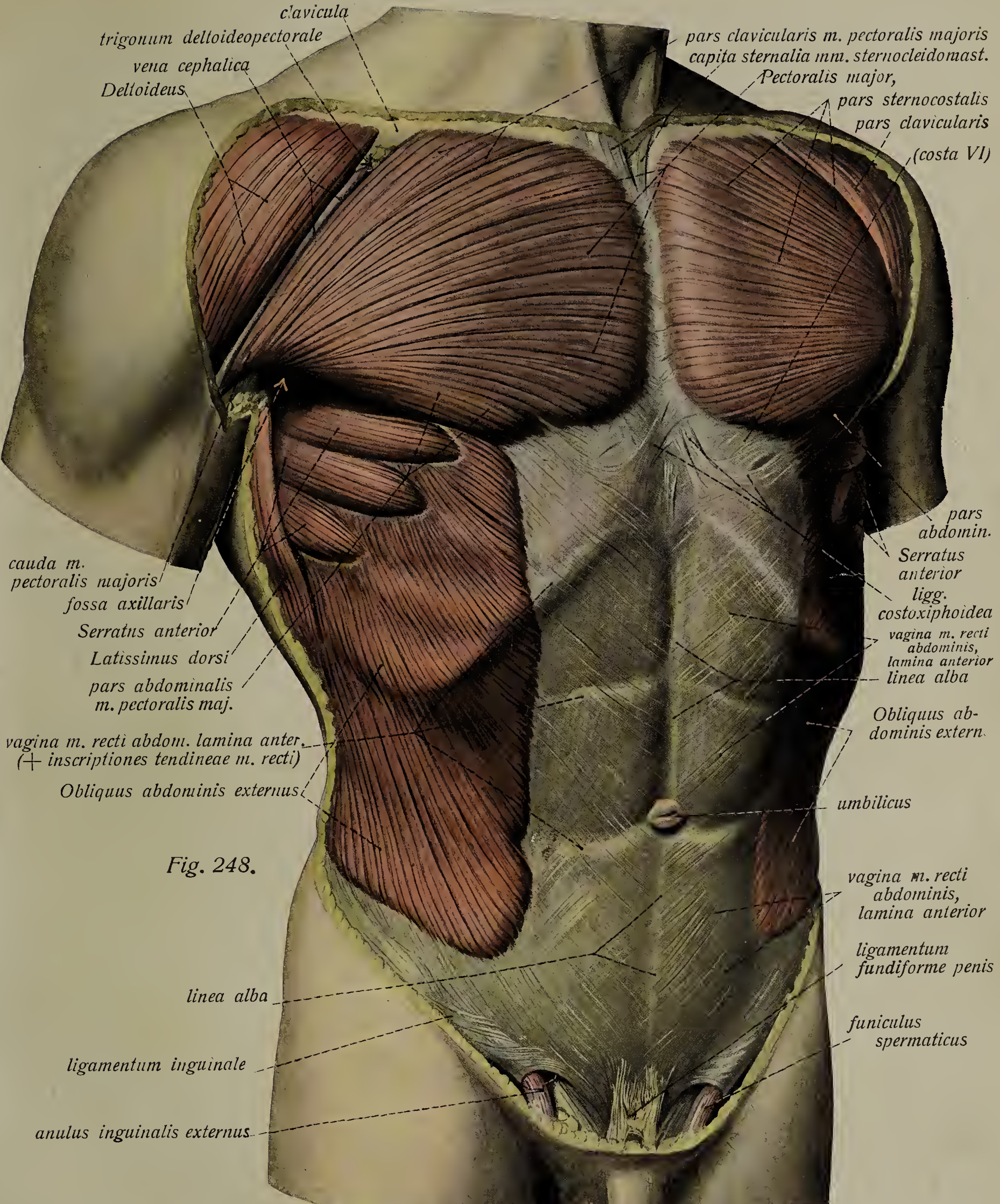

clavicula
trigonum deltoideopectorale
vena cephalica
Deltoideus
pars clavicularis m. pectoralis majoris
capita sternalia mm. sternocleidomast.
Pectoralis major,
pars sternocostalis
pars clavicularis
(costa VI)
pars abdomin.
Serratus anterior
ligg. costoxiphoidea
vagina m. recti abdominis, lamina anterior
linea alba
Obliquus abdominis extern.
umbilicus
vagina m. recti abdominis, lamina anterior
ligamentum fundiforme penis
funiculus spermaticus
cauda m. pectoralis majoris
fossa axillaris
Serratus anterior
Latissimus dorsi
pars abdominalis m. pectoralis maj.
vagina m. recti abdom. lamina anter.
(+ inscriptiones tendineae m. recti)
Obliquus abdominis externus
linea alba
ligamentum inguinale
anulus inguinalis externus

Fig. 248.

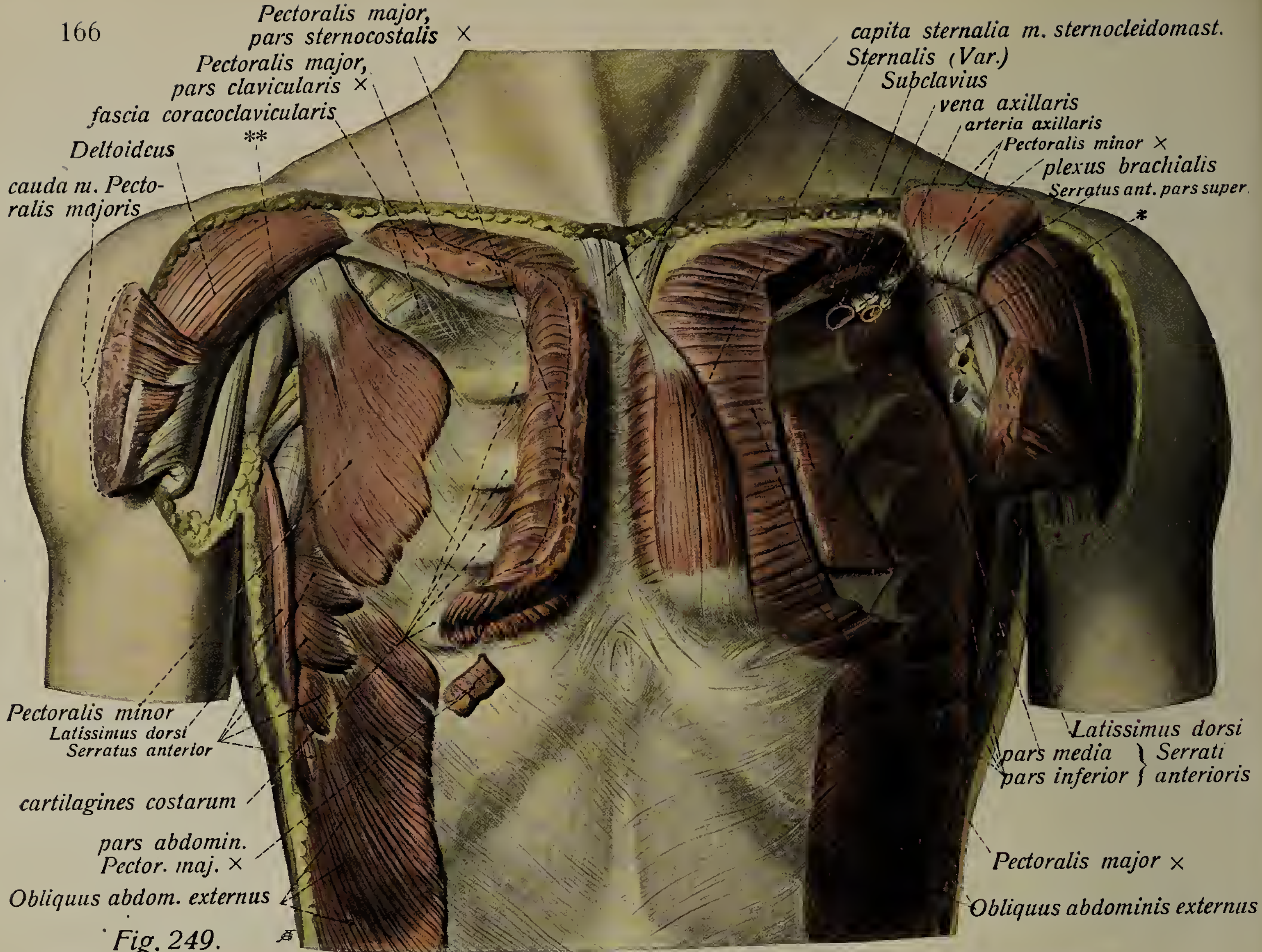


Fig. 249.

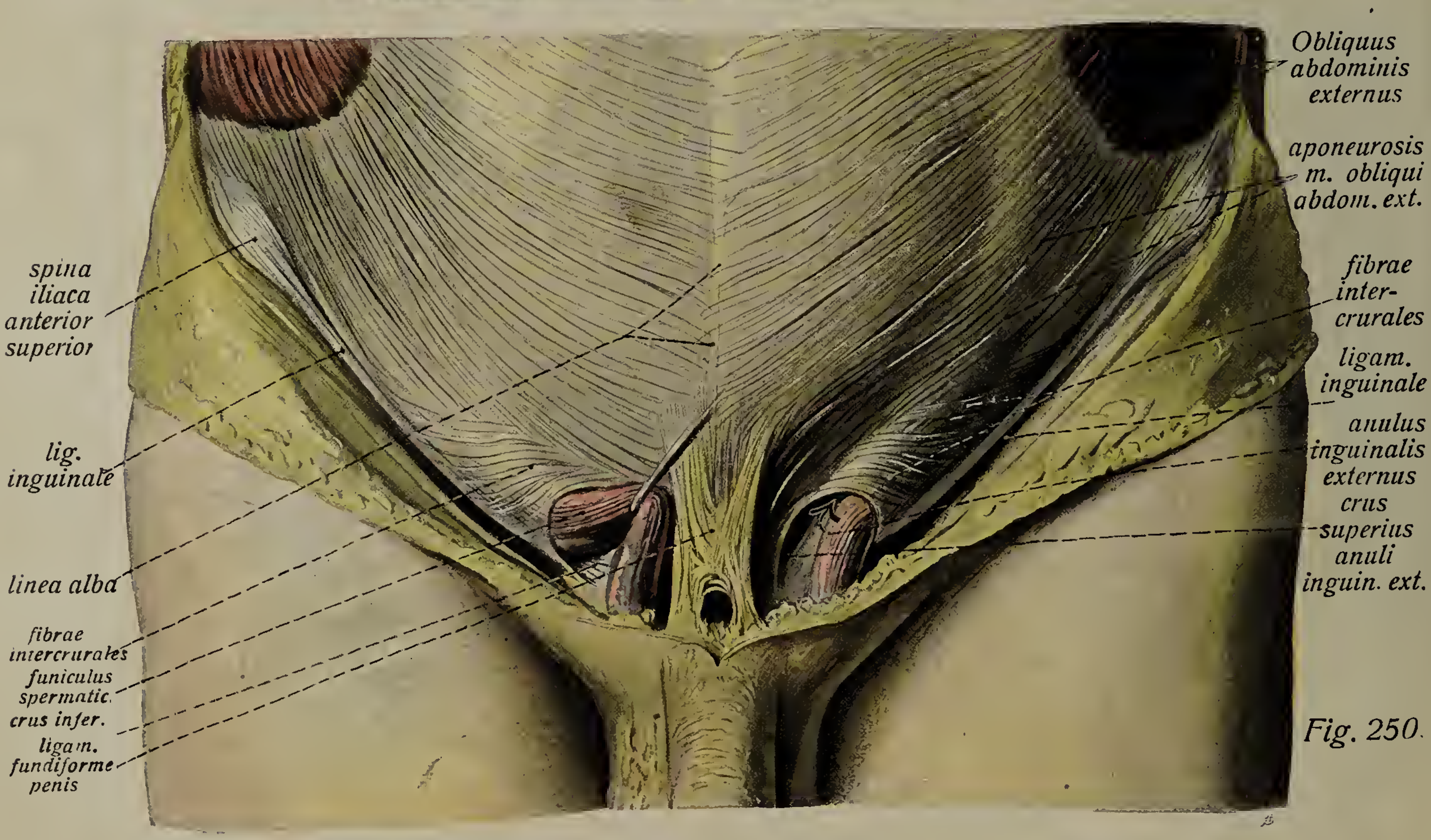

Obliquus abdominis externus
aponeurosis m. obliqui abdom. ext.
spina iliaca anterior superior
fibrae intercrurales
ligam. inguinale
lig. inguinale
anulus inguinalis externus
crus superius anuli inguin. ext.
linea alba
fibrae intercrurales
funiculus spermatic.
crus infer.
ligam. fundiforme penis

Fig. 250.

The Pectoral and Abdominal Muscles.

Fig. 249. The deeper layer of the pectoral muscles. (1/4)
On the right the pectoralis major is divided and reflected; on the left the pectoralis minor also. * = subscapular fascia. ** = axillary cavity.

Fig. 250. Superficial layer of the abdominal muscles, lower portion, with the inguinial ring. (3/7)
On the right the spermatic cord is drawn upward to show the inferior limb of the ring.

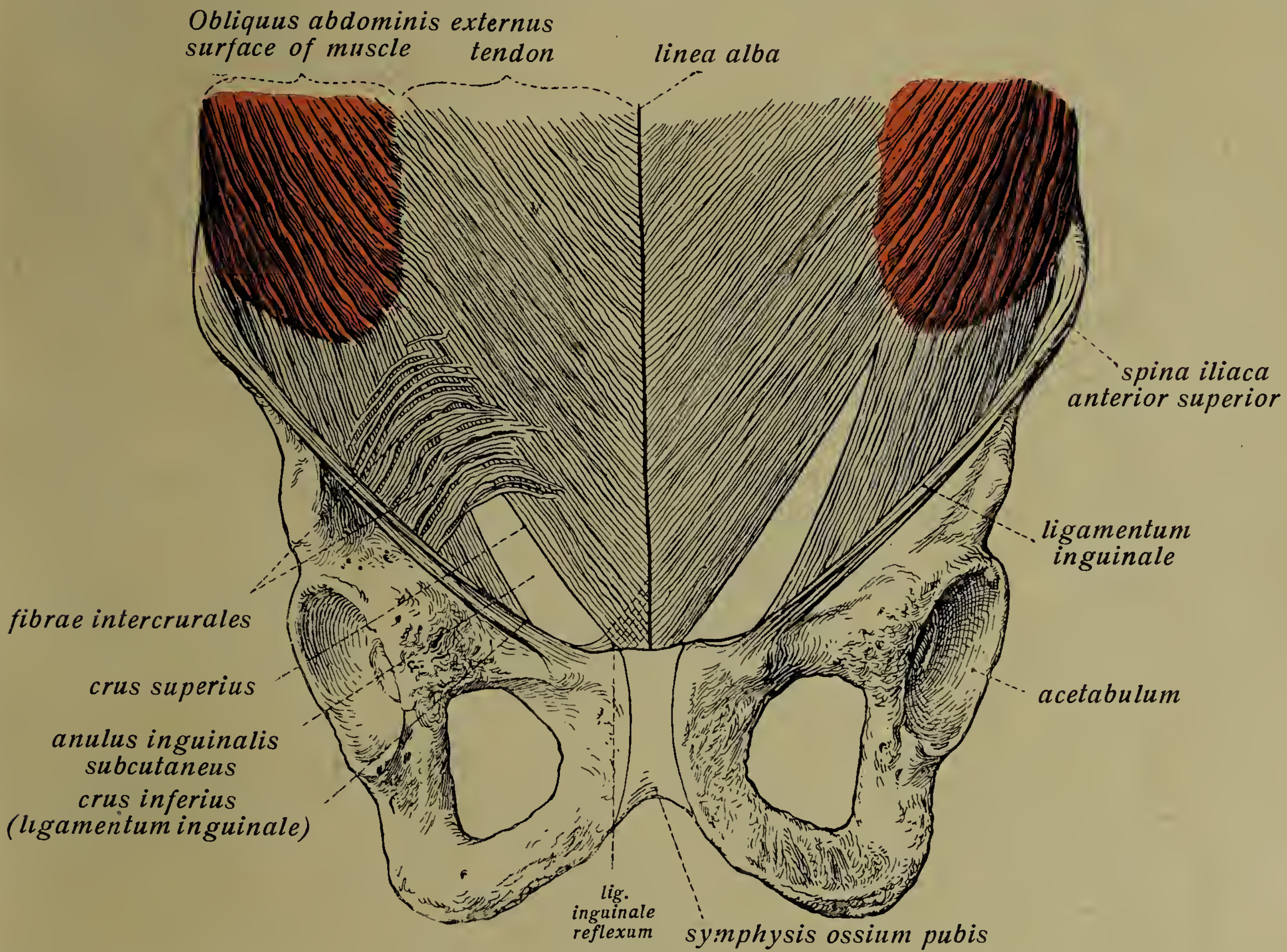


Fig. 251. Diagram of the superficial inguinal ring; only on the right is the share of the aponeurosis of the external oblique in its formation fully shown.

In the aponeurosis of the *Obliquus abdominis externus* a triangular cleft occurs, no fibres inserting between the pubic tubercle and the upper border of the symphysis. The lateral angle of the cleft is rounded off by superficial, arched *intercrural fibres,* and the medial angle by the *reflexed inguinal ligament,* extending upwards from the insertion of the inguinal ligament. The irregularly quadrangular opening so formed is the *subcutaneous inguinal ring,* through which the spermatic cord passes in the male and the *ligamentum teres* of the uterus in the female. The borders of the aponeurosis that bound the ring are termed the *crura (superius* and *inferius).*

The Abdominal Muscles.

Fig. 252. The second layer of the abdominal muscles from in front and from the right. (1/2)

On the left the anterior wall of the sheath of the rectus is divided lengthwise, exposing the rectus and pyramidalis, on the right the obliquus externus is cut and reflected. * = linea alba.

The Oblique Abdominal Muscles.

The **Obliquus externus** arises by seven or eight digitations from the fifth or sixth to the twelfth rib. It is inserted into the lateral lip of the iliac crest and into the inguinal ligament and the anterior wall of the sheath of the rectus. *Nerve:* The lower intercostal nerves and branches from the lumbar plexus, the ilio-hypogastric and ilio-inguinal. *Action:* Compresses the abdomen, draws the trunk forward or rotates it to the same side, raises the pelvis.

The **Obliquus internus** arises from the intermediate line of the iliac crest, from the lumbo-dorsal fascia and from the lateral two-thirds of the inguinal ligament. It is inserted into the lower borders of the last three ribs and the linea alba, its tendon forming the anterior wall of the sheath of the rectus and the upper part of its posterior wall. *Nerves:* The lower intercostals and branches of the lumbar plexus (ilio-hypogastric, ilio-inguinal and genito-femoral). *Action:* Similar to that of the external oblique.

The **Cremaster** arises from the lower bundles of the internal oblique and from the anterior wall of the sheath of the rectus, and is continued down over the spermatic cord to the scrotum. *Nerve:* External spermatic. *Action:* Draws the testis upwards.

The **Transversus** arises from the inner surfaces of the last six ribs, from the lumbo-dorsal fascia and from the inner lip of the iliac crest and the lateral third of the inguinal ligament. It is inserted at the *linea semilunaris* into the posterior wall of the sheath of the rectus and, below, into the anterior wall. *Nerves:* The lower intercostals and branches from the lumbar plexus (iliohypogastric, ilioinguinal and genito-femoral). *Action:* Compresses the abdomen.

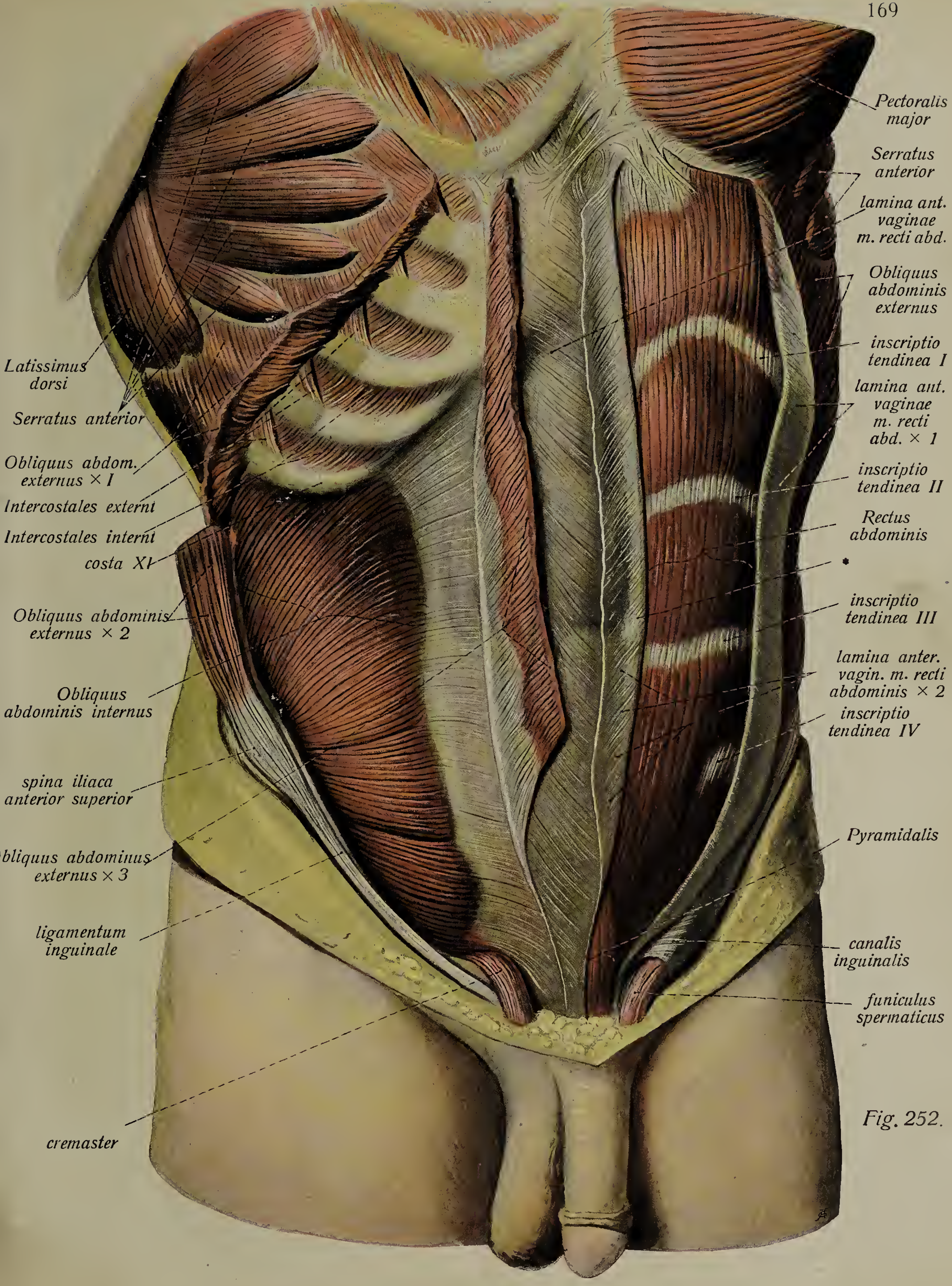

Latissimus dorsi
Serratus anterior
Obliquus abdom. externus × I
Intercostales externi
Intercostales interni
costa XI
Obliquus abdominis externus × 2
Obliquus abdominis internus
spina iliaca anterior superior
bliquus abdominus externus × 3
ligamentum inguinale
cremaster
Pectoralis major
Serratus anterior
lamina ant. vaginae m. recti abd.
Obliquus abdominis externus
inscriptio tendinea I
lamina ant. vaginae m. recti abd. × 1
inscriptio tendinea II
Rectus abdominis
*
inscriptio tendinea III
lamina anter. vagin. m. recti abdominis × 2
inscriptio tendinea IV
Pyramidalis
canalis inguinalis
funiculus spermaticus

Fig. 252.

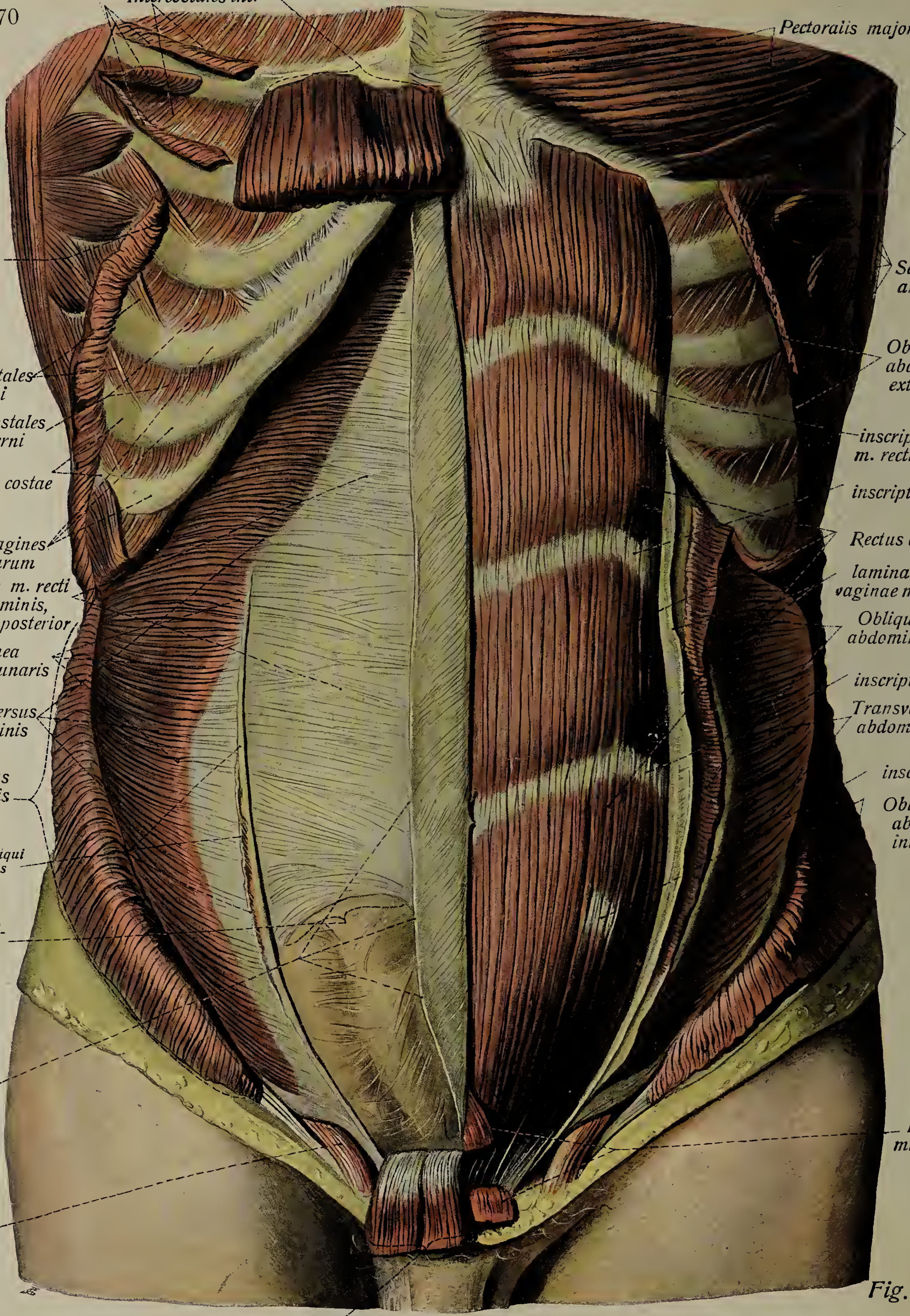

Intercostales externi ×
Intercostales int.
Rectus abdominis ×
Pectoralis major
Latissimus dorsi
Obliquus abdominis externus
Serratus anterior
Obliquus abdominis externus ×
Intercostales externi
Intercostales interni
inscriptio I m. recti abdom.
costae
inscriptio II
cartilagines costarum
Rectus abdomin.
lamina anter. vaginae m. recti ×
vagina m. recti abdominis, lamina posterior
Obliquus abdomin. int.
linea semilunaris
inscriptio III
Transversus abdominis
Transversus abdominis
Obliquus abdominis internus
inscriptio IV
Obliquus abdominis internus ×
tendo m. obliqui abdominis interni
linea semicircularis
vagina m. recti abdominis sinistr. ×
Pyramidalis ×
funiculus spermaticus
m. rectus abdominis ×

Fig. 253.

The Abdominal Muscles. (Cont.)

Fig. 253. The deep layer of the abdominal muscles. (½)
On the left the rectus is exposed and the pyramidalis and internal oblique are cut. On the right the internal oblique has been reflected and the rectus removed, to show the semilunar and semicircular lines.

The Rectus Muscles.

The **Rectus abdominis** arises from the cartilages of the fifth to the seventh rib and from the xiphoid process, and inserts into the upper border of the pubis between the tubercle and the upper border of the symphysis. The muscle fibres are interrupted by *tendinous inscriptions*, of which three are constant; an upper, in the region of the costal arch; a lower in the neighborhood of the umbilicus; and a middle between these. A fourth sometimes occurs below the umbilicus and usually only in the lateral part of the muscle. At the inscriptions the muscle unites with the anterior wall of its sheath, from which elsewhere it is separated by loose connective tissue. The posterior wall does not unite with the inscriptions; it ends below at the *semicircular line* (Douglas' line), the lower part of the muscle having behind it only the fascia transversalis. *Nerves:* The middle and lower intercostals and occasionally the first lumbar. *Action:* It bends the trunk forward or raises the pelvis; it also aids in compressing the abdominal contents.

The **Pyramidalis** is an inconstant muscle that arises immediately in front of the origin of the rectus. It is inserted into the linea alba above the symphysis. *Nerves:* The lower intercostals. *Action:* Tenses the linea alba.

The Abdominal Muscles. (Cont.)

Fig. 255. The deep layer of the trunk muscles seen from the left side. ($^3/_7$)

Both pectorales are cut, the clavicle is disarticulated from the sterno-clavicular joint and partly cut away, the arm is drawn backwards to show the serratus anterior in its full extent and the two oblique muscles have been cut. In the neck the sterno-mastoid, sterno-hyoid, omohyoid, anterior belly of the digastric and mylohyoid have been cut.

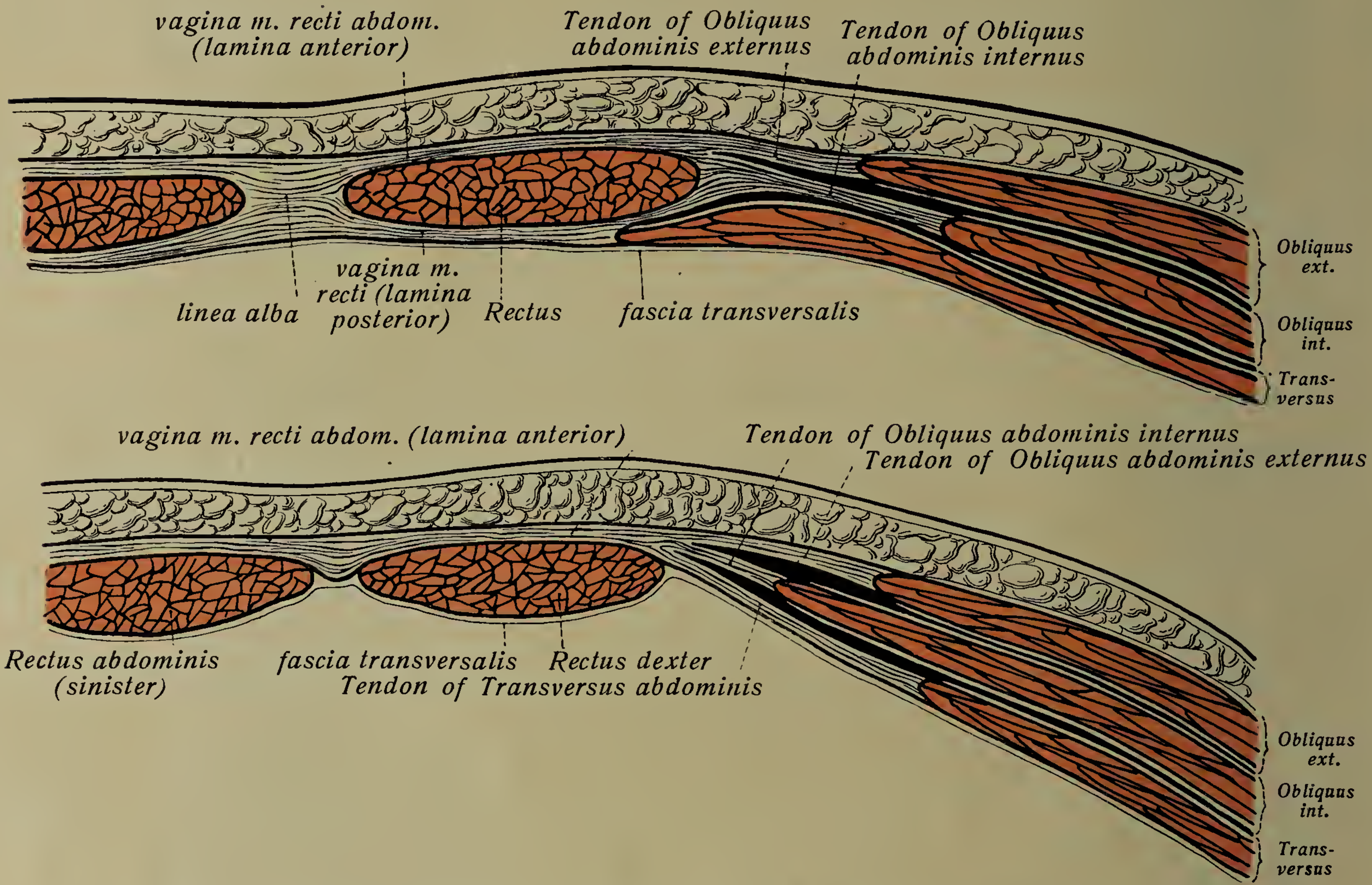

vagina m. recti abdom. (lamina anterior)
Tendon of Obliquus abdominis externus
Tendon of Obliquus abdominis internus
Obliquus ext.
Obliquus int.
Trans-versus
linea alba
vagina m. recti (lamina posterior)
Rectus
fascia transversalis
vagina m. recti abdom. (lamina anterior)
Tendon of Obliquus abdominis internus
Tendon of Obliquus abdominis externus
Obliquus ext.
Obliquus int.
Trans-versus
Rectus abdominis (sinister)
fascia transversalis
Rectus dexter
Tendon of Transversus abdominis

Fig. 254. Transverse sections of the anterior abdominal wall, above the umbilicus and between the umbilicus and the symphysis (schematic).

The tendon of the obliquus internus forms both walls of the sheath (vagina) of the rectus, which is strengthened in front by the obliquus externus and behind by the transversus. In the lower third of the abdomen the posterior wall is completely wanting below the *semicircular line* (Douglasi) (see p. 171), all three muscles passing to the anterior wall. In the middle line the sheaths of the two rectus muscles unite to form a broad, tendinous strip, the *linea alba*, that extends from the xiphoid process to the upper border of the symphysis pubis.

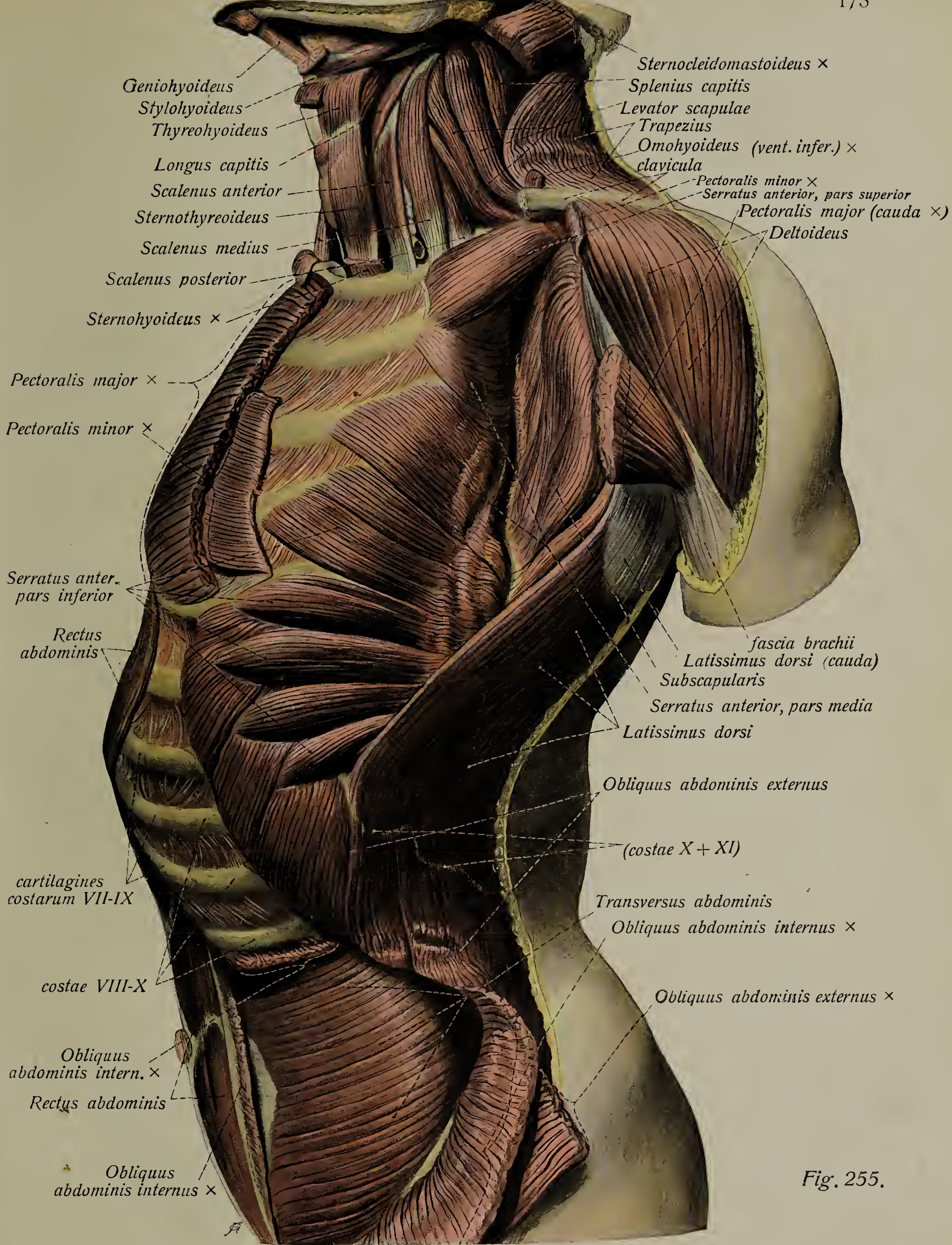

Geniohyoideus
Stylohyoideus
Thyreohyoideus
Longus capitis
Scalenus anterior
Sternothyreoideus
Scalenus medius
Scalenus posterior
Sternohyoideus ×
Pectoralis major ×
Pectoralis minor ×
Serratus anter. pars inferior
Rectus abdominis
cartilagines costarum VII-IX
costae VIII-X
Obliquus abdominis intern. ×
Rectus abdominis
Obliquus abdominis internus ×
Sternocleidomastoideus ×
Splenius capitis
Levator scapulae
Trapezius
Omohyoideus (vent. infer.) ×
clavicula
Pectoralis minor ×
Serratus anterior, pars superior
Pectoralis major (cauda ×)
Deltoideus
fascia brachii
Latissimus dorsi (cauda)
Subscapularis
Serratus anterior, pars media
Latissimus dorsi
Obliquus abdominis externus
(costae X + XI)
Transversus abdominis
Obliquus abdominis internus ×
Obliquus abdominis externus ×

Fig. 255.

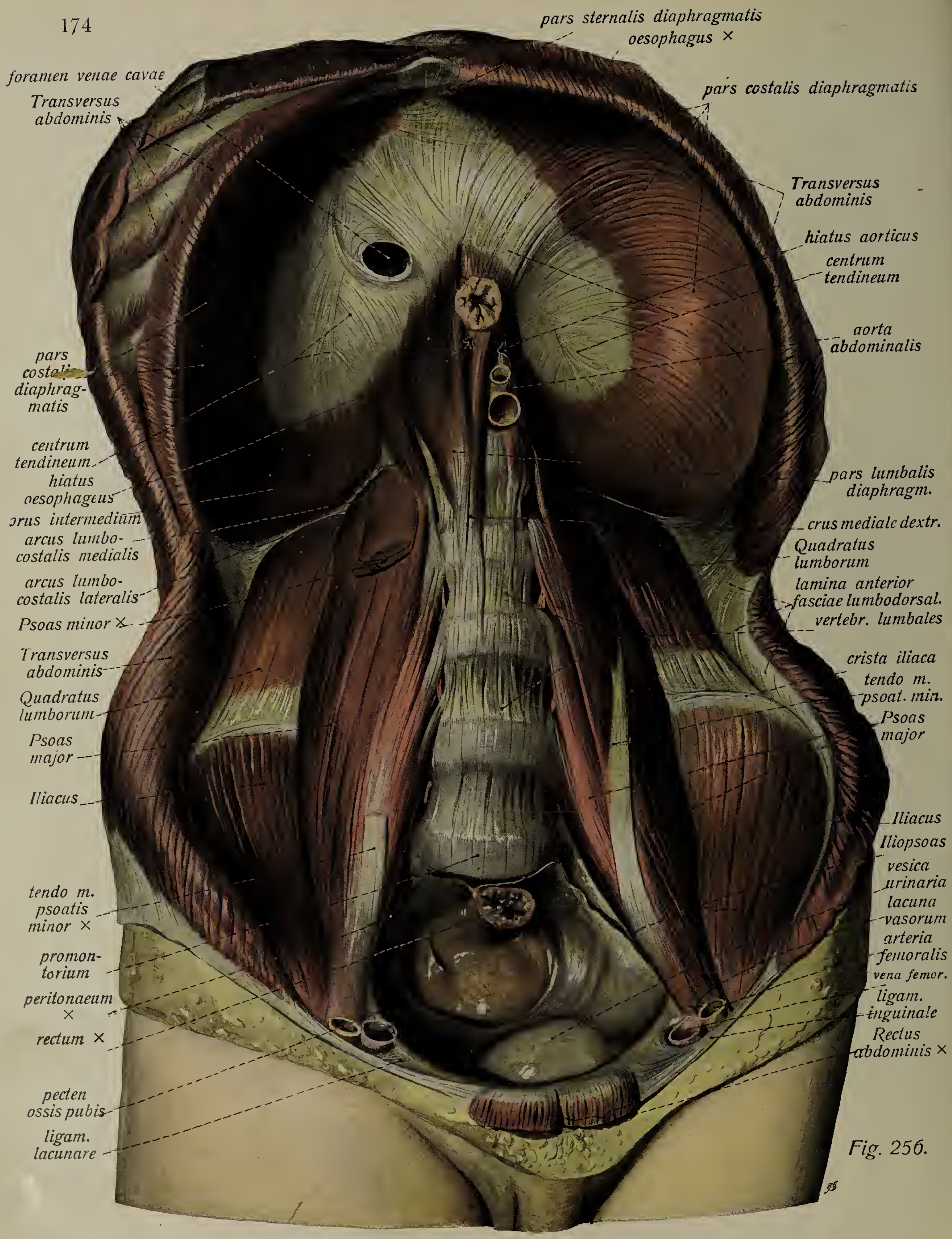

pars sternalis diaphragmatis
oesophagus ×
foramen venae cavae
Transversus abdominis
pars costalis diaphragmatis
Transversus abdominis
hiatus aorticus
centrum tendineum
aorta abdominalis
pars costalis diaphragmatis
centrum tendineum
hiatus oesophageus
crus intermedium
arcus lumbocostalis medialis
arcus lumbocostalis lateralis
Psoas minor ×
Transversus abdominis
Quadratus lumborum
Psoas major
Iliacus
pars lumbalis diaphragm.
crus mediale dextr.
Quadratus lumborum
lamina anterior fasciae lumbodorsal.
vertebr. lumbales
crista iliaca
tendo m. psoat. min.
Psoas major
Iliacus
Iliopsoas
vesica urinaria
lacuna vasorum
arteria femoralis
vena femor.
ligam. inguinale
Rectus abdominis ×
tendo m. psoatis minor ×
promontorium
peritonaeum ×
rectum ×
pecten ossis pubis
ligam. lacunare

Fig. 256.

The Diaphragm, Iliopsoas and Quadratus lumborum.

Fig. 256. The muscles of the posterior abdominal wall and the diaphragm, from the right and in front. ($1/2$)

The anterior abdominal wall is opened and its muscles reflected. The abdominal contents above the small pelvis have been removed. The thorax is bent backward, the lumbar vertebrae being made strongly convex anteriorly, and twisted so that the left dome of the diaphragm is seen completely. On the right a portion of the psoas minor has been removed.

The **Diaphragm** arises by its *sternal portion* from the xiphoid process of the sternum, by its *costal portion* from the inner surface of the last six ribs and their cartilages, and by its *lumbar portion* from the lumbar vertebrae by three pairs of *crura.* The medial crura are attached to the anterior surfaces of the third and fourth vertebrae the *intermediate crura* to the lateral surfaces of the body of the second vertebra and the *lateral crura* to the transverse processes of the first vertebra and to the lumbo-costal arches. From these origins the fibres radiate to a trifoliate *central tendon.* Between the medial crura is the *aortic opening (hiatus);* in the muscular part of its lumbar portion, the *oesophageal opening;* and in the central tendon, the *foramen for the vena cava.* Between the medial and intermediate crura and between the latter and the lateral there are gaps, and also between the costal and sternal portions. *Nerve:* Phrenic from the cervical plexus. *Action:* A muscle of respiration, inspiratory.

The **Iliopsoas** consists of two or three parts, the **Psoas major, Psoas minor** and **Iliacus.** The **Psoas major,** arises from the upper and lower borders of the bodies of the twelfth thoracic to the fourth lumbar vertebra and from the fibrocartilages between these; also from the transverse processes of all the lumbar vertebrae. The **Psoas minor** is inconstant; when present it arises from the bodies of the last thoracic and first lumbar vertebrae and is inserted into the iliac fascia and the iliopectineal eminence. The **Iliacus** arises from the whole of the iliac fossa. It unites with the psoas major, and the combined muscle passes over the crest of the pubis and over the capsule of the hip joint, separated from this by the *iliopectineal bursa,* and inserts into the lesser trochanter of the femur. *Nerves:* Branches from the lumbar plexus. *Action:* Flexes the thigh, rotates it inwards and aids in adduction. The psoas minor tenses the iliac fascia.

The Posterior Abdominal Muscle.

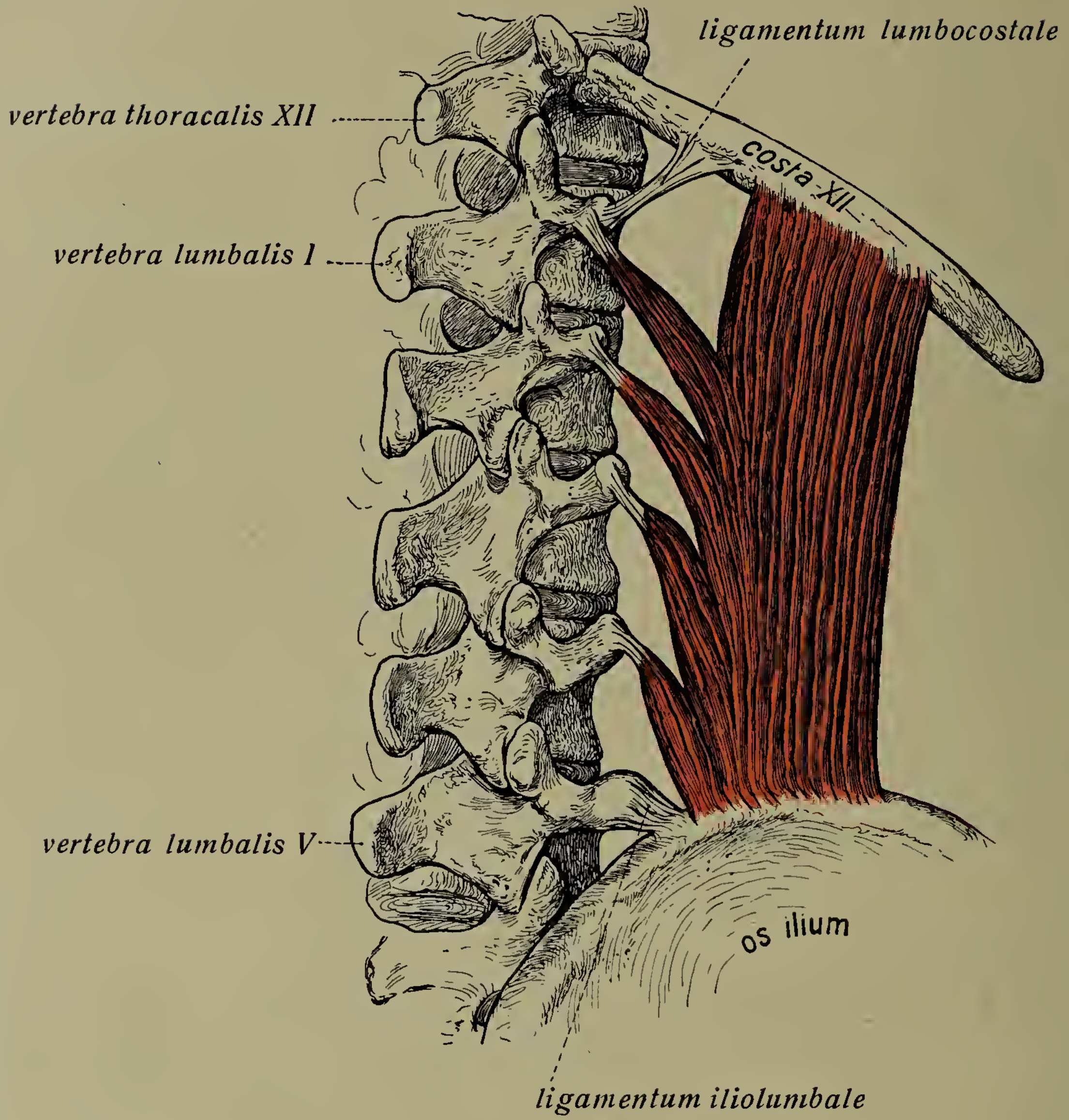


Fig. 257. The quadratus lumborum from the side and somewhat from behind. (Schematic.)

The **Quadratus lumborum** arises from the medial lip of the iliac crest, the iliolumbar ligament and the transverse processes of the lower lumbar vertebrae. Its fibres form two parallel layers which are partly interwoven. It inserts into the medial half of the twelfth rib and into the transverse processes of the upper and middle lumbar vertebrae. *Nerves:* Branches from the lumbar plexus and the twelfth intercostal. *Action:* Draws the last rib downwards and bends the lumbar vertebrae laterally.

Tab. 1.

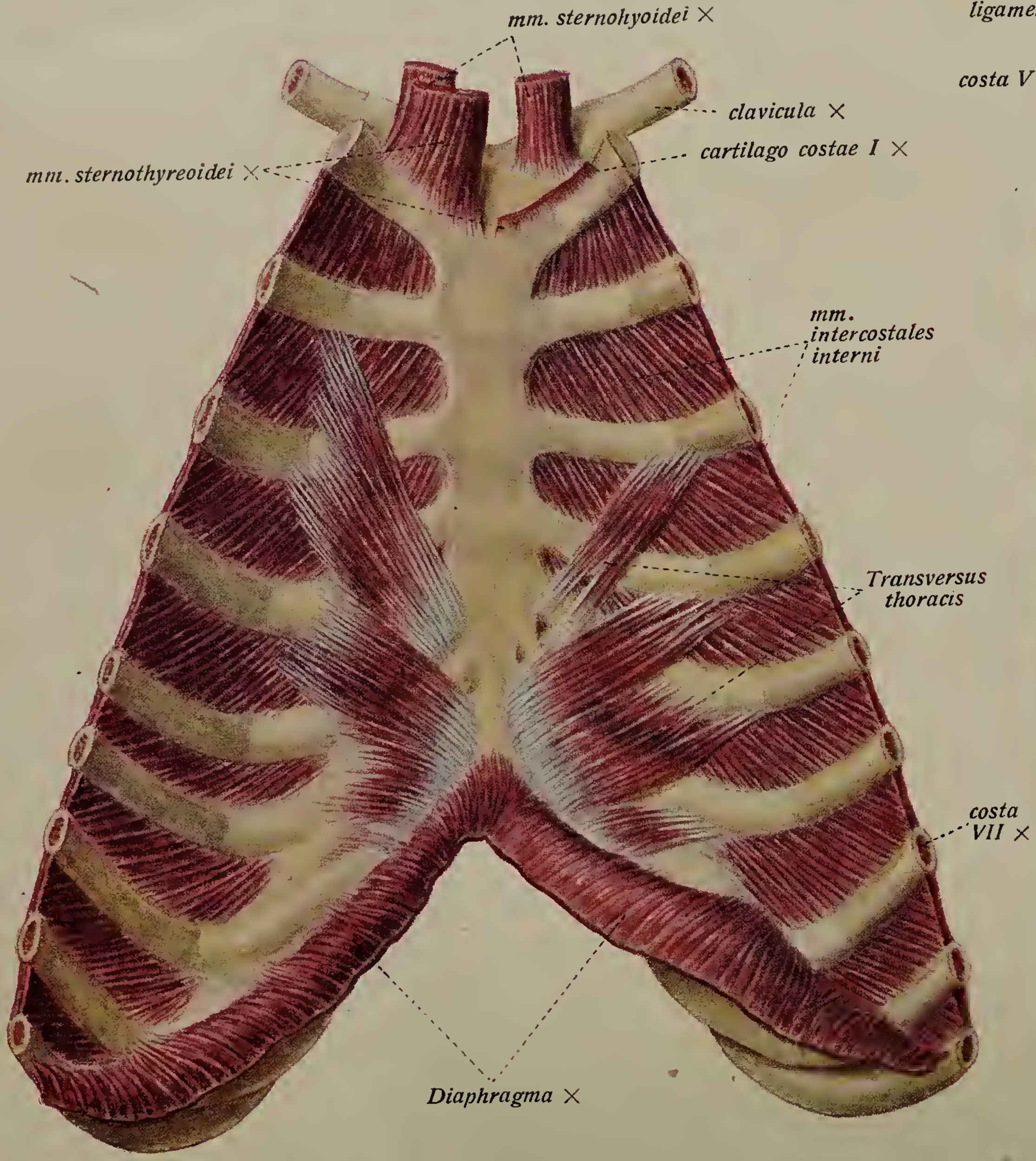


Fig. 1.

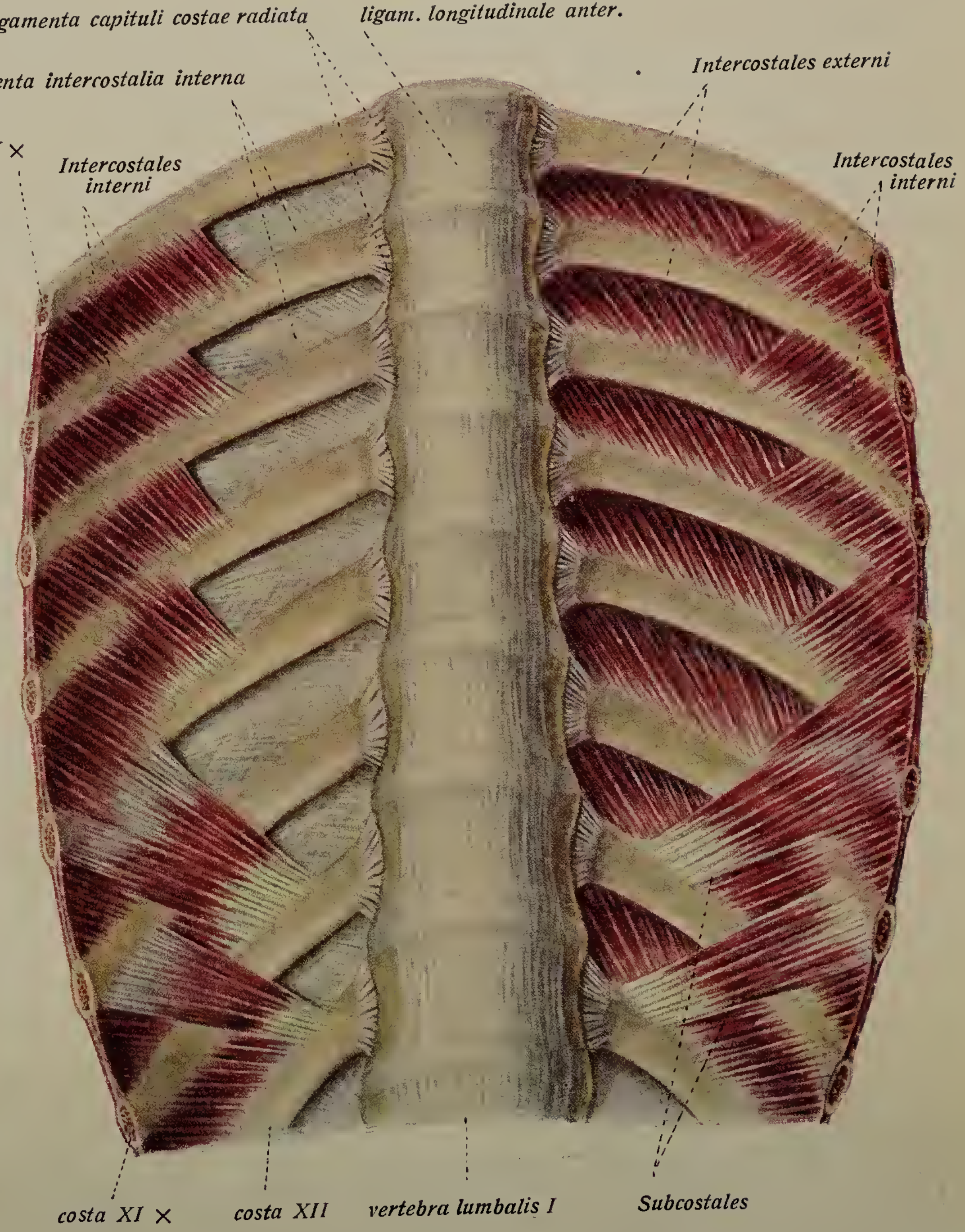


Fig. 2.

The Muscles of the Thoracic Wall.

Plate 1.

The **External intercostals** pass between the opposed borders of successive ribs, beginning behind the tuberosity and ending in front shortly before the junction of the ribs and their cartilages. Their fibres are directed from above downwards and inwards, like those of the external oblique. In the region of the costal cartilages they are continued as tendinous bundles, the *external intercostal ligaments*.

The **Internal intercostals** are covered by the external, except in the region of the cartilages. Their fibres are directed upwards and inwards, like those of the internal oblique, and are lacking at the hinder ends of the ribs, between the angles and the tuberosities, where they are replaced by the *internal intercostal ligaments*.

The **Subcostales** immediately succeed the internal intercostals. They are not quite constant and differ from the internal intercostals in that they occur at the hinder portions of the ribs and pass over one or more. They occur only on the lower ribs and are usually largely tendinous.

The **Transversus thoracis** *(triangularis sterni)* arise from the posterior surface of the body of the sternum and the xiphoid process and is inserted into the inner surfaces of the cartilages of the second (third) to the sixth rib.

Nerves: The intercostals are supplied by the intercostal nerves which run between the external and internal. The transversus thoracis and levatores costarum are also supplied by these nerves. *Action*: The intercostals are respiratory muscles; the externals and the portions of the internals between the costal cartilages serve in inspiration, as do also probably the rest of the intercostals and the subcostals, though they have been held to act in expiration.

For the *Levatores costarum* see p. 163.

Fig. 1. The sternum and the sternal ends of the clavicles and the ribs, with the associated muscles from behind. ($^{3}/_{7}$)

Fig. 2. The fifth to the twelfth thoracic vertebrae and the vertebral ends of the corresponding ribs, with their muscles, from in front. ($^{3}/_{7}$)

On the left the internal intercostal ligaments are removed.

Fig. 258. The right Platysma. (1/2)
* = crossing of the bundles under the chin. In addition to the relief of the sterno-mastoid that of the external jugular vein may be seen.

The Pectoral Fasciae*).

The *pectoral fascia*, which covers the pectoralis major and serratus anterior, is merely a portion of the general fascia. An in part much stronger sheet, the *coraco-clavicular fascia,* lies between the pectoralis major and pectoralis minor, covering the subclavius and the axillary vessels. It is especially strong where it rests on the subclavius, and is attached to the under surface of the clavicle.

The Abdominal Fasciae.

The superficial layer of the abdominal muscles is covered by the general fascia, but this, in the region of the inguinal ring in the lower region of the abdomen, acquires a very considerable strength and is continued as the *cremasteric fascia* (Cooper's) upon the spermatic cord. For the rectus its sheath serves as fascia. The inner surface of the transversus, the anterior surface of the quadratus lumborum and the posterior surface of the posterior wall of the sheath of the rectus are covered by the *transversalis fascia.* Over these structures the fascia is especially strong and it is firmly fused with the tendinous portion of the transversus and the posterior wall of the sheath of the rectus. Below the linea semicircularis it alone forms the posterior wall of the sheath. Above the symphysis it fuses with a triangular, tendinous offset from the superior pubic ligament, the *adminiculum lineae albae.* At the inguinal ligament, with which it unites, the transversalis passes over into the *iliopectineal fascia;* above it is lost on the under surface of the diaphragm.

The Muscles of the Neck.

The **Platysma** arises from the skin covering the pectoral and deltoid fasciae and is inserted into the skin over the base of the mandible, the chin and face. *Nerve:* Ramus colli of the facial nerve. *Action:* contracts the skin of the neck and upper part of the thorax and tenses the cervical fascia.

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*) Fasciae of the neck, see p. 193.

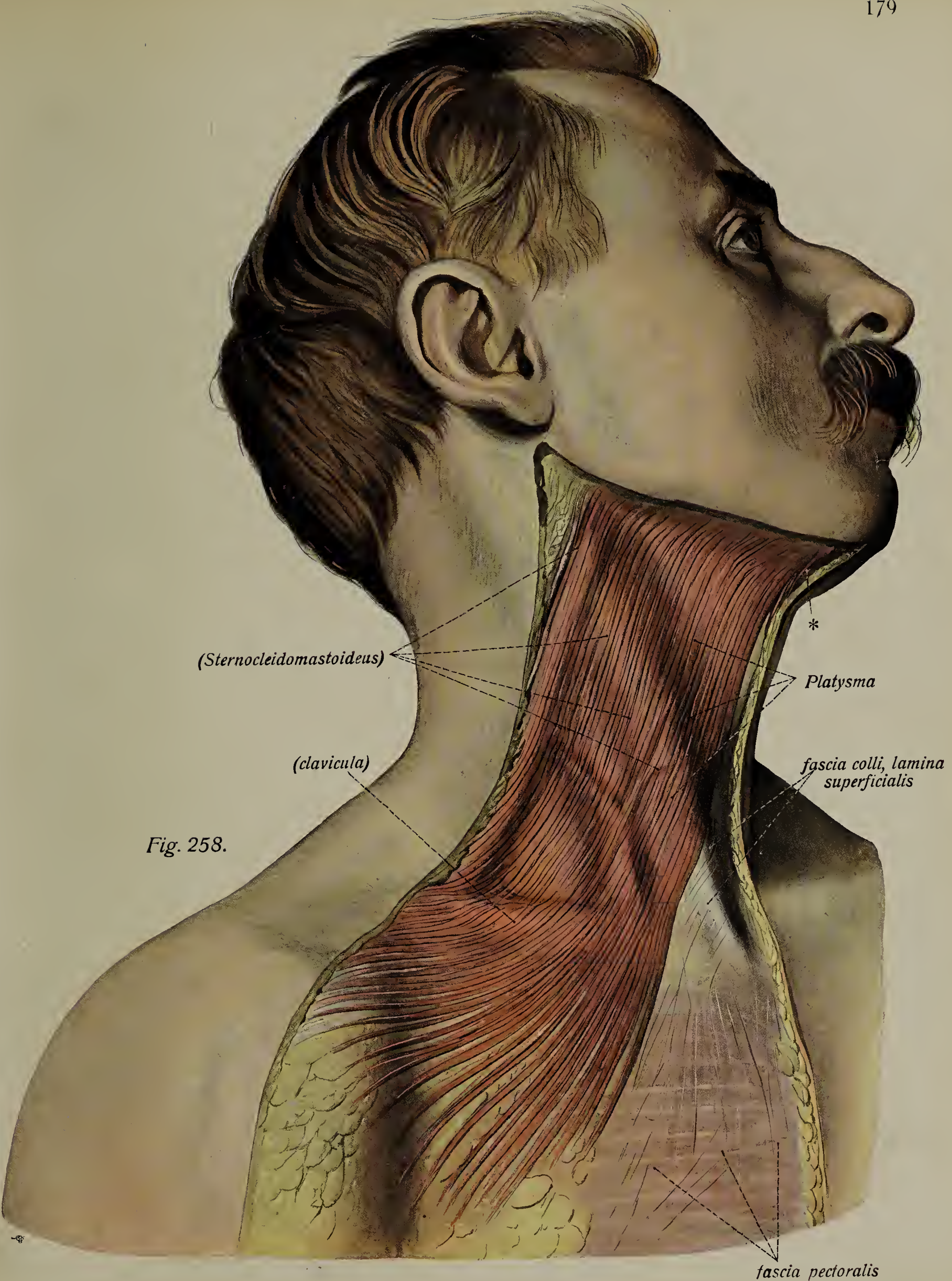
*
(Sternocleidomastoideus)
Platysma
(clavicula)
fascia colli, lamina superficialis
fascia pectoralis

Fig. 258.

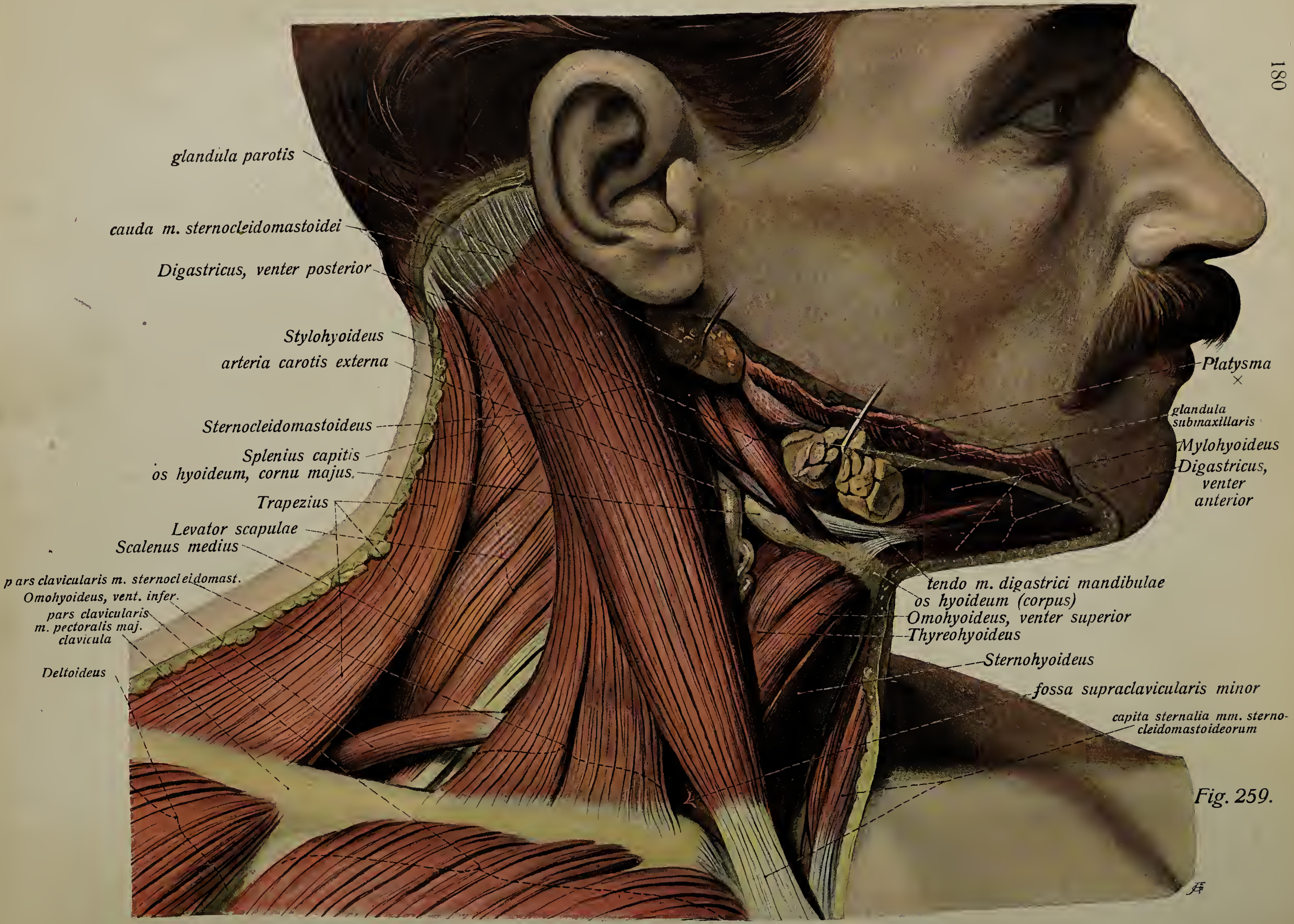
glandula parotis
cauda m. sternocleidomastoidei
Digastricus, venter posterior
Stylohyoideus
arteria carotis externa
Sternocleidomastoideus
Splenius capitis
os hyoideum, cornu majus
Trapezius
Levator scapulae
Scalenus medius
pars clavicularis m. sternocleidomast.
Omohyoideus, vent. infer.
pars clavicularis
m. pectoralis maj.
clavicula
Deltoideus
Platysma
×
glandula
submaxillaris
Mylohyoideus
Digastricus,
venter
anterior
tendo m. digastrici mandibulae
os hyoideum (corpus)
Omohyoideus, venter superior
Thyreohyoideus
Sternohyoideus
fossa supraclavicularis minor
capita sternalia mm. sterno-
cleidomastoideorum

Fig. 259.

The Muscles of the Neck. (Cont.)

The Sterno-mastoid.

The **Sterno-mastoid** *(sterno-cleido-mastoid)* arises by a *sternal head* from the anterior surface of the manubrium sterni and by a *clavicular head* from the sternal end of the clavicle. It is inserted into the lateral part of the base of the mastoid process and the lateral half of the superior nuchal line. *Nerve:* The spinal accessory. *Action:* Fixes the head, turns the face upwards. If only one acts, the head is drawn to the same side and rotated towards the opposite one.

Hyoid Muscles.

a) The Infrahyoid Muscles.

The **Sterno-hyoideus** arises from the upper border of the first costal cartilage, the posterior surface of the manubrium and the sterno-clavicular joint. It has frequently a tendinous inscription in its lower part, and inserts into the body of the hyoid bone.

The **Sterno-thyroideus** arises from the inner surface of the first costal cartilage and from the posterior surface of the manubrium. It also frequently has a tendinous inscription in its lower part, and inserts into the outer surface of the thyreoid cartilage.

The **Thyreo-hyoideus** arises from the outer surface of the thyreoid cartilage and is inserted into the lateral third of the body of the hyoid and into the root of the greater cornu.

The **Omohyoideus** arises from the upper border of the scapula between the medial angle and the scapular notch. It is divided in the middle of its course into two bellies by an intervening tendon, and is inserted into the lower border of the lateral part of the body of the hyoid.

Nerves: All four muscles are supplied from the ansa hypoglossi. The thyreo-hyoideus usually has a direct branch from the hypoglossal. *Action:* Draw the hyoid bone and larynx downwards and assist in swallowing. The omohyoideus by the union of its intermediate tendon with the cervical fascia, widens the internal Jugular vein (Fig. 261) and tenses the fascia.

Fig. 259. The Superficial layer of muscles on the right side of the neck. $(^{9}/_{10})$
The cervical fascia has been removed and the submaxillary gland displaced upwards.

The Muscles of the Neck. (Cont.)

Fig. 261. The superficial and middle layers of the muscles of the neck, from in front. ($^4/_5$) On the left the anterior belly of the digastric is cut; on the right the sterno-mastoid and sterno-hyoid. * = middle layer of cervical fascia.

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b) The Suprahyoid Muscles.

The **Digastricus** is divided into two bellies by an intermediate tendon which is attached to the hyoid bone. The *posterior belly (venter)* arises from the notch on the mastoid process and the *anterior belly* is attached to the digastric fossa of the mandible. *Nerves:* The anterior belly is supplied by the mylohyoid and the posterior by the facial. *Action:* Opens the mouth, raises and fixes the hyoid bone.

The **Stylo-hyoideus** arises from the styloid process of the temporal and is inserted by two slips into the anterior and posterior borders of the lateral part of the hyoid. The intermediate tendon of the *digastric* passes between the two slips of insertion. *Nerve:* The facial. *Action:* Fixes the hyoid, drawing it upward and laterally.

The **Mylo-hyoideus** arises from the mylohyoid line of the mandible. The muscle forms the floor of the mouth extending across the arch of the mandible. Its more median fibres unite in a median raphe; the lateral insert into the upper border of the body of the hyoid. *Nerve:* The mylohyoid from the third division of the trigeminus. *Action:* Raises the floor of the mouth, depresses the mandible, aids in deglutition.

The **Genio-hyoideus** arises from the mental spine and inserts into the anterior border of the body of the hyoid. *Nerve:* Hypoglossal. *Action:* Aids the mylohyoid, fixes the hyoid and depresses the mandible.

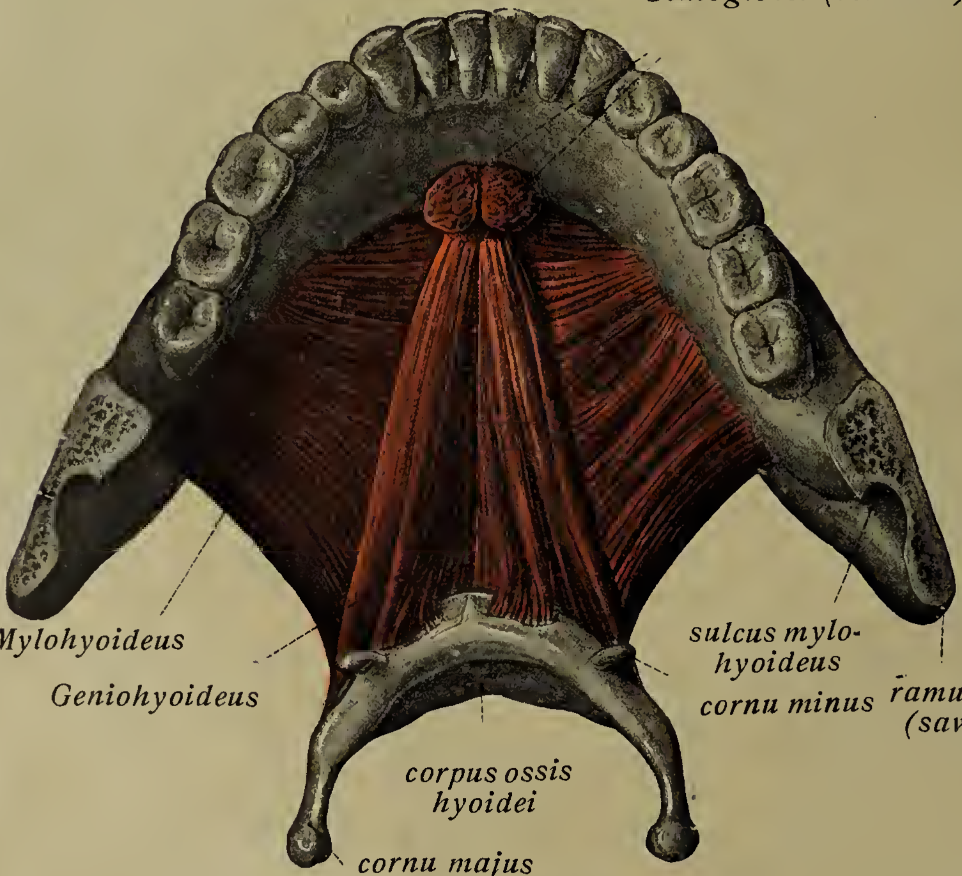


Fig. 260.

The two mylohyoidei and the genio-hyoidei from above. The two genioglossi are cut near their origins and the rami of the mandible are cut across.

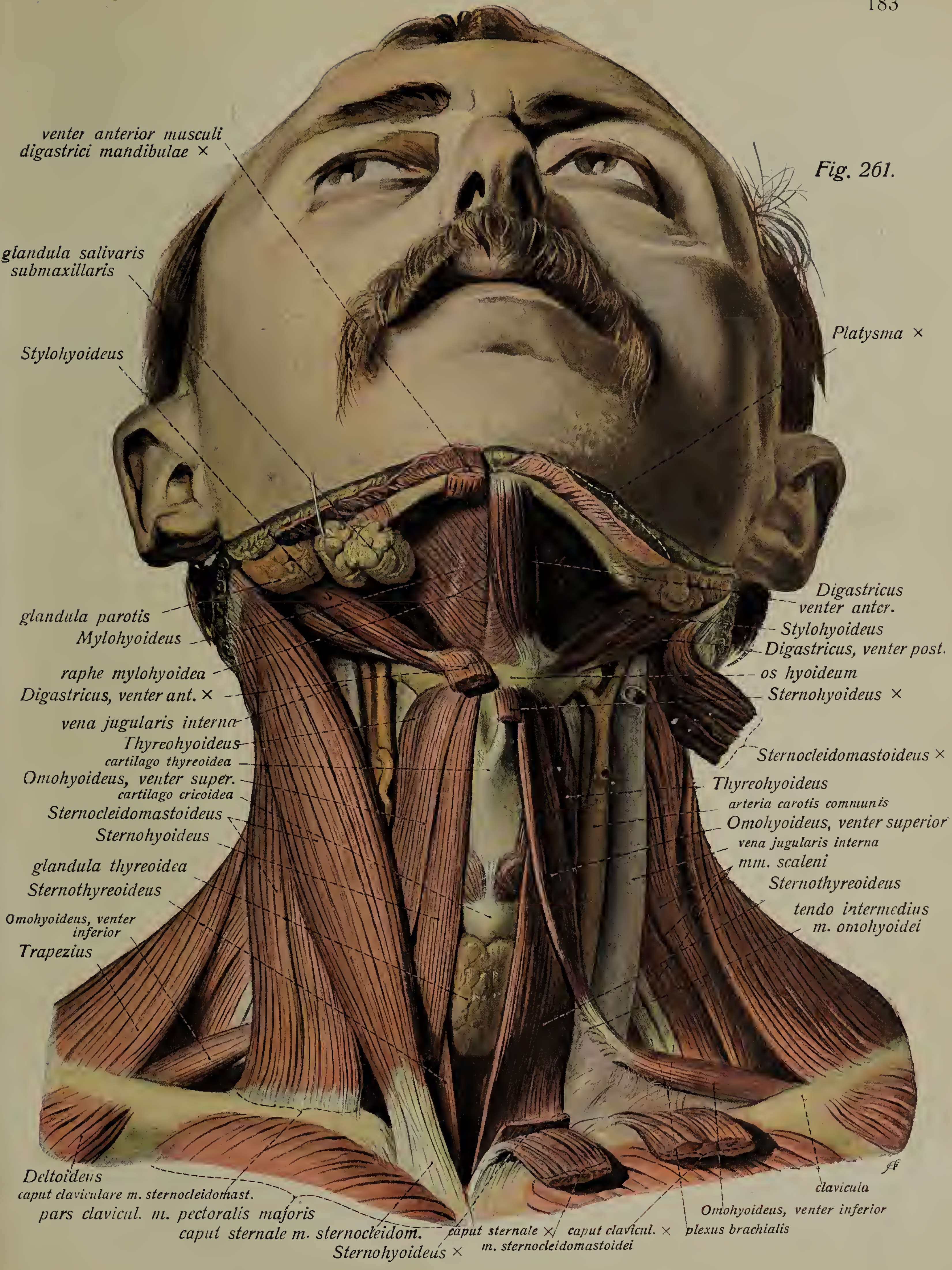

venter anterior musculi digastrici mandibulae ×
glandula salivaris submaxillaris
Stylohyoideus
glandula parotis
Mylohyoideus
raphe mylohyoidea
Digastricus, venter ant. ×
vena jugularis interna
Thyreohyoideus
cartilago thyreoidea
Omohyoideus, venter super.
cartilago cricoidea
Sternocleidomastoideus
Sternohyoideus
glandula thyreoidea
Sternothyreoideus
Omohyoideus, venter inferior
Trapezius
Deltoideus
caput claviculare m. sternocleidomast.
pars clavicul. m. pectoralis majoris
caput sternale m. sternocleidom.
Sternohyoideus ×
caput sternale ×
caput clavicul. ×
m. sternocleidomastoidei
plexus brachialis
Omohyoideus, venter inferior
clavicula
tendo intermedius m. omohyoidei
Sternothyreoideus
mm. scaleni
vena jugularis interna
Omohyoideus, venter superior
arteria carotis communis
Thyreohyoideus
Sternocleidomastoideus ×
Sternohyoideus ×
os hyoideum
Digastricus, venter post.
Stylohyoideus
Digastricus venter anter.
Platysma ×

Fig. 261.

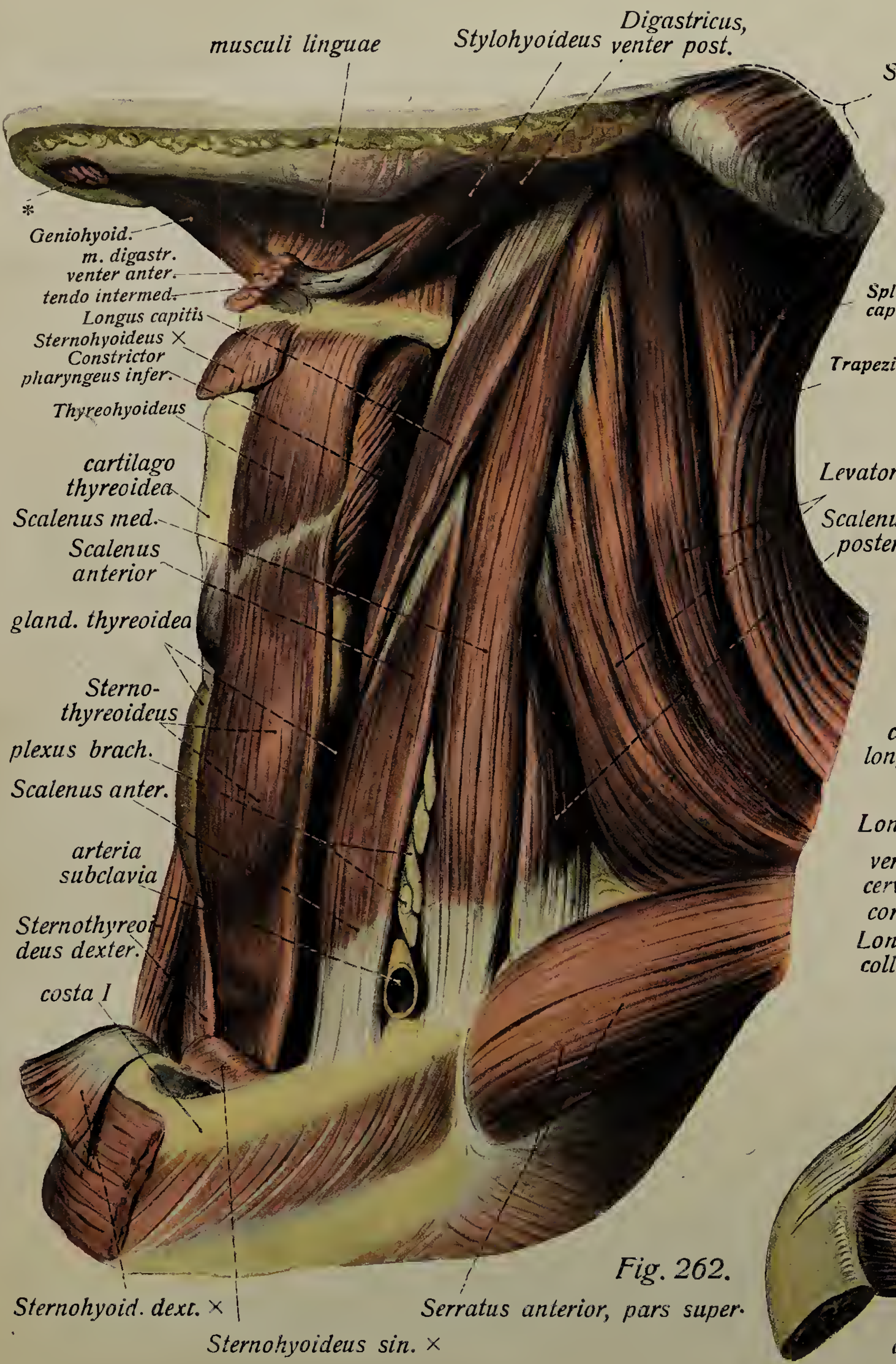


Fig. 262.

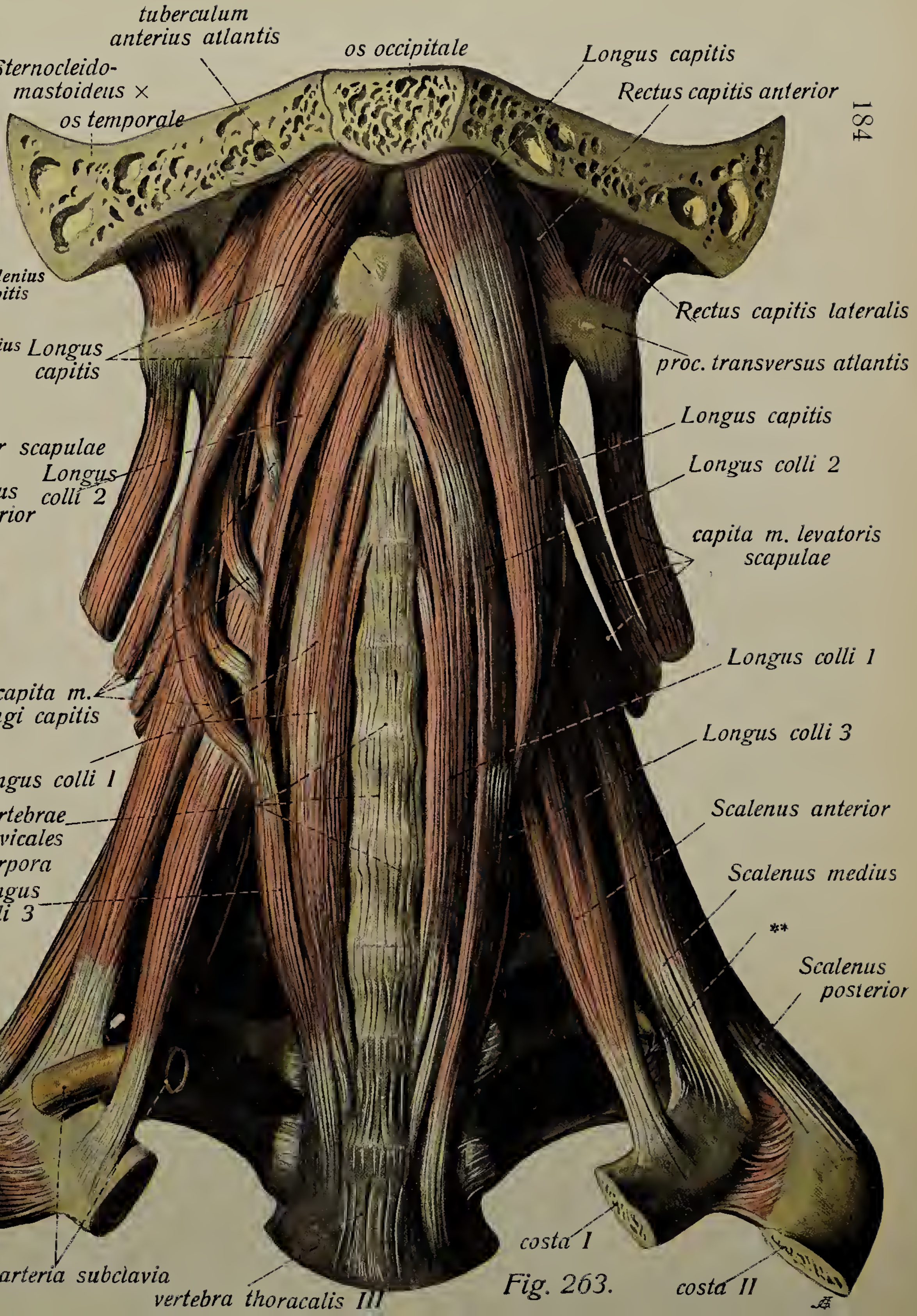


Fig. 263.

The Muscles of the Neck. (Cont.)

The Scalene Muscles.

The **Scalenus anterior** arises from the anterior tubercles of the transverse processes of the third (fourth) to the sixth cervical vertebrae and is inserted into the scalene tubercle of the first rib.

The **Scalenus medius** arises from the anterior tubercles of the transverse processes of all the cervical vertebrae. It is inserted into the first rib, lateral to the preceding.

The **Scalenus posterior** arises from the posterior tubercles of the transverse processes of the fifth to the sixth (seventh) cervical vertebrae and inserts into the upper border of the second rib.

Nerves: From the cervical and brachial plexuses. *Action:* Elevate the upper two ribs. Muscles of respiration.

The Praevertebral Muscles.

The **Longus colli** arises by a medial limb from the bodies of the upper thoracic and lower cervical vertebrae; by an upper lateral limb from the anterior tubercles of the transverse processes of the upper cervical vertebrae; and by a lower lateral limb from the lateral surfaces of the bodies of the upper thoracic vertebrae. It inserts by its medial limb into the bodies of the upper cervical vertebrae; by its upper lateral limb into the anterior tubercle of the atlas and the bodies of the succeeding vertebrae; and by its lower lateral limb into the transverse processes of the lower cervical vertebrae, especially the sixth.

The **Longus capitis** arises from the anterior tubercles of the transverse processes of the third to the sixth cervical vertebrae and inserts into the lower surface of the basilar portion of the occipital.

The **Rectus capitis anterior** has its origin from the root of the transverse process of the atlas and is inserted close to the preceding muscle.

Nerves: Special branches of the cervical plexus. *Action:* Bend the vertebral column anteriorly; acting singly bend the head to the same side.

Fig. 262. The deep layers of the muscles of the neck, from the left side. ($^4/_5$)
The sternomastoid, anterior belly of the digastric, mylohyoid, sternohyoid and the cervical vessels and nerves have been cut or removed.
+ = insertion of the anterior belly of digastric. * = longus capitis.

Fig. 263. The deep muscles of the neck from in front. ($^3/_4$)
The base of the skull is sawn across, the first and second costal cartilages are removed and the levator scapulae is cut. On the right the longus capitis and colli show their parts. ** = scalene opening; 1, 2, 3, indicate the medial, upper lateral and lower lateral limbs of the longus colli.

The Muscles of the Head.

Fig. 264. The superficial muscles of the head, from the right. ($^4/_5$)
* = slip of quadratus labii superioris to the ala of the nose. ** = buccal fat pad.
+ = platysma bundles from the parotideo-masseteric fascia.

I. The Facial Muscles.

The facial muscles include the epicranius with the associated auricular muscles, the orbicular muscle of the eyelids, the muscles of the mouth and those of the nose.

They differ from most of the other skeletal muscles in many respects; they are in the deeper layers of the skin, they generally lack fascia, they are entirely fleshy or have very short tendons. Frequently adjacent muscles are imperfectly separated; thus the muscles of the mouth region unite together in the upper and lower lip.

The Epicranial Muscles.

The epicranial muscles are attached to a common tendinous sheet, the *galea aponeurotica,* which covers the whole vault of the skull.

The **Frontalis** arises from the upper border of the orbit and is attached above to the galea aponeurotica.

The **Procerus** is attached to the nasal bones and unites above with the frontalis.

The **Occipitalis** arises from the supreme nuchal line and passes to the galea aponeurotica.

Nerve: The facial. *Action:* Move the scalp.

The Auricular Muscles.

The **Auricularis anterior** *(attrahens)* arises from the superficial temporal fascia and from the margin of the galea aponeurotica; the **Auricularis superior** *(attollens)* arises from the galea aponeurotica in the temporal region; and the **Auricularis posterior** *(retrahens)* from the tendon of insertion of the sterno-mastoid. The three muscles insert into the root of the auricular cartilage. *Nerve:* The facial. *Action:* Move the auricle.

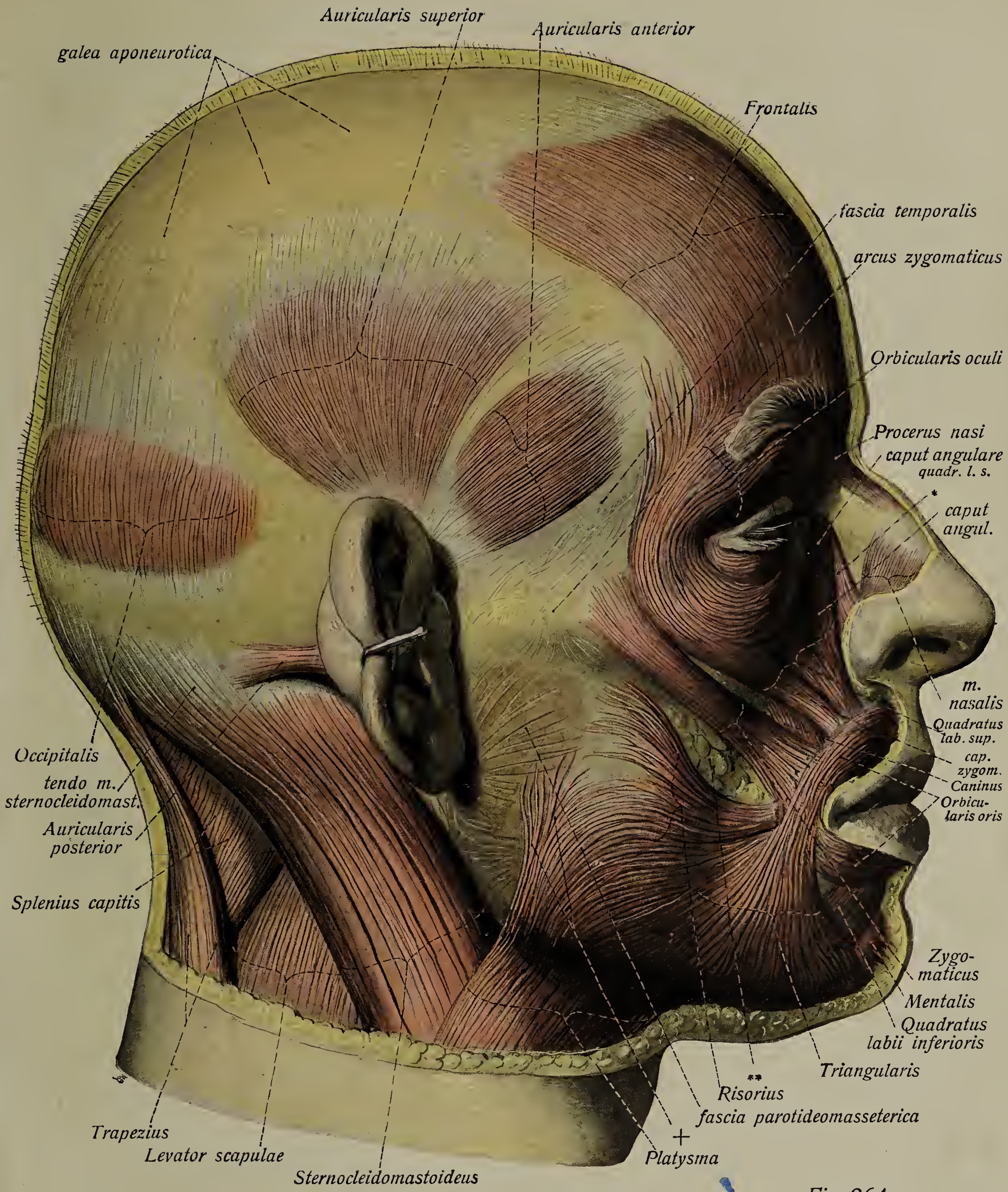

Auricularis superior
Auricularis anterior
galea aponeurotica
Frontalis
fascia temporalis
arcus zygomaticus
Orbicularis oculi
Procerus nasi
caput angulare
quadr. l. s.
*
caput
angul.
m.
nasalis
Quadratus
lab. sup.
cap.
zygom.
Caninus
Orbicu-
laris oris
Occipitalis
tendo m.
sternocleidomast.
Auricularis
posterior
Splenius capitis
Zygo-
maticus
Mentalis
Quadratus
labii inferioris
Triangularis
**
Risorius
fascia parotideomasseterica
+
Platysma
Trapezius
Levator scapulae
Sternocleidomastoideus

Fig. 264.

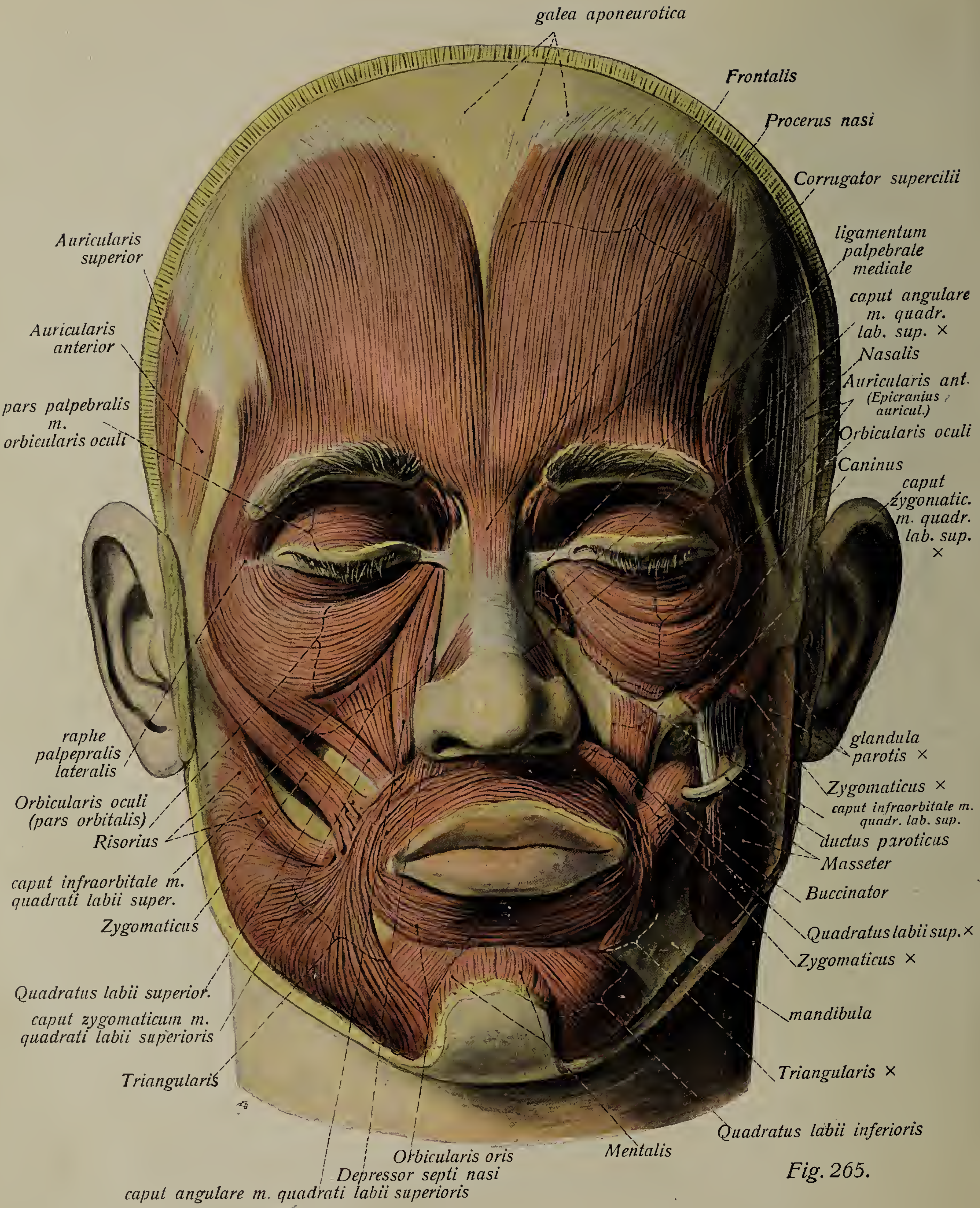

galea aponeurotica
Frontalis
Procerus nasi
Corrugator supercilii
ligamentum palpebrale mediale
caput angulare m. quadr. lab. sup. ×
Nasalis
Auricularis ant. (Epicranius auricul.)
Orbicularis oculi
Caninus
caput zygomatic. m. quadr. lab. sup. ×
Auricularis superior
Auricularis anterior
pars palpebralis m. orbicularis oculi
raphe palpepralis lateralis
glandula parotis ×
Zygomaticus ×
caput infraorbitale m. quadr. lab. sup.
ductus paroticus
Masseter
Orbicularis oculi (pars orbitalis)
Risorius
caput infraorbitale m. quadrati labii super.
Buccinator
Zygomaticus
Quadratus labii sup. ×
Zygomaticus ×
Quadratus labii superior.
caput zygomaticum m. quadrati labii superioris
mandibula
Triangularis
Triangularis ×
Quadratus labii inferioris
Mentalis
Orbicularis oris
Depressor septi nasi
caput angulare m. quadrati labii superioris

Fig. 265.

The Muscles of the Head. Facial Muscles (Cont.)

Fig. 265. Surface and deeper layer of the musculature of the face from in front. ($^4/_5$)
On the right the Triangularis, Platysma, Zygomaticus, Quadratus labii superioris are cut, the fascia parotideomasseterica and a part of the salivary gland of the ear are taken away, and thus the deeper layer is exposed.

The Muscle of the Eyelid.

The **Orbicularis oculi** has three portions. The *orbital portion* arises from the frontal process of the maxilla at the medial angle of the orbit and its fibres arch over to the lateral angle; some of the deep fibres insert into the supraciliary arch *(corrugator supercilii)*. The *palpebral portion* has its origin in the medial palpebral ligament and inserts into the lateral palpebral raphe, while the *lacrimal portion* (Horner's muscle) is attached medially to the posterior lacrimal crest and fuses laterally with the palpebral portion. *Nerve:* The facial. *Action:* Closes the eyelids, compresses the lacrimal sac.

The Muscles of the Mouth.

The **Quadratus labii superioris** arises by three heads. The *angular head* arises from the surface of the nasal bone and passes partly to the ala of the nose and partly to the upper lip. The *infraorbital head* arises from the infraorbital border and the *zygomatic head* from the malar surface of the zygomatic bone ; the two heads pass to the upper lip.

The **Zygomaticus** arises from the malar surface of the zygomatic bone and passes to the angle of the mouth.

Nerve: The facial. *Action:* Movement of the upper lip, the ala of the nose and the angle of the mouth.

The Muscles of the Head. Facial Muscles (Cont.)

Fig. 266. The left orbicularis oculi. ($^1/_1$)
Fig. 267. The muscles of the mouth, from within. ($^1/_1$)

The Muscles of the Mouth. (Cont.)

The **Risorius** arises from the parotideo-masseteric fascia and passes to the angle of the mouth.

The **Triangularis** *(depressor anguli oris)* arises from the anterior end of the base of the mandible and passes to the angle of the mouth and the lower lip.

The **Caninus** *(levator anguli oris)* arises from the canine fossa of the maxilla and passes to the upper lip and the angle of the mouth.

The **Quadratus labii inferioris** arises from the anterior part of the base of the mandible and passes to the lower lip.

The **Incisivus labii superioris** arises from the jugum of the upper lateral incisor tooth and passes to the upper lip.

The **Depressor septi nasi** arises from the cartilaginous septum of the nose and passes to the upper lip.

The **Buccinator** arises from the buccinator crest of the mandible, the posterior end of the alveolar process of the maxilla and the pterygo-mandibular raphe. Its fibres at the angle of the mouth are continued into the upper and lower lips, arching around the mouth to form the orbicularis oris.

The **Mentalis** *(levator menti)* arises from near the jugum of the lower medial incisor tooth and passes to the skin of the chin. *Nerve:* The facial. *Action:* Move the lips, cheeks and chin.

The Muscles of the Nose.

The **Nasalis** consists of two portions, a *transverse portion* arising from the maxilla and passing transversely to the bridge of the nose, and an *alar portion* from the jugum of the upper canine tooth to the ala of the nose. *Nerve:* The facial. *Action:* Slight movement of the nose.

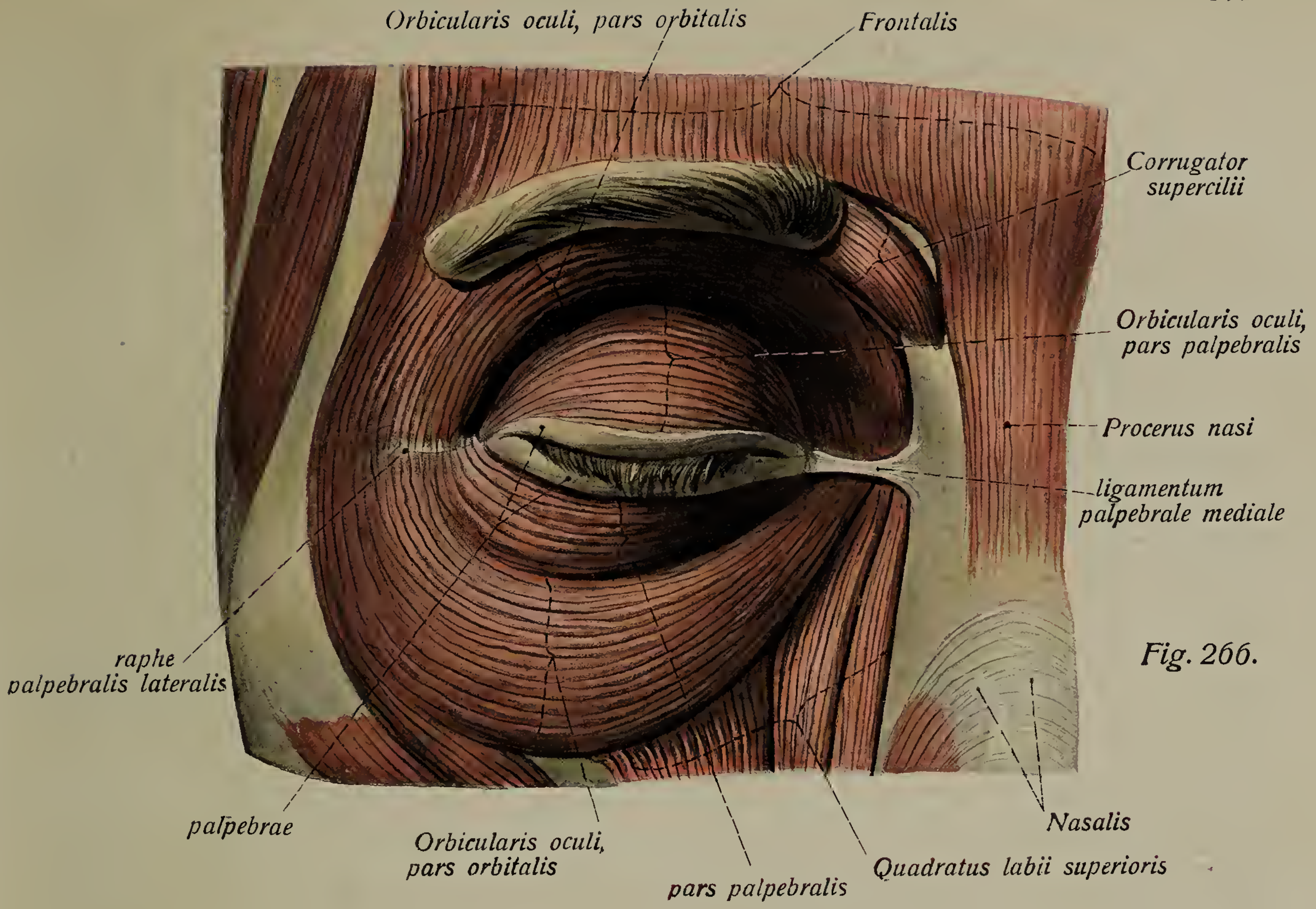

Orbicularis oculi, pars orbitalis
Frontalis
Corrugator supercilii
Orbicularis oculi, pars palpebralis
Procerus nasi
ligamentum palpebrale mediale
raphe palpebralis lateralis
palpebrae
Orbicularis oculi, pars orbitalis
pars palpebralis
Quadratus labii superioris
Nasalis

Fig. 266.

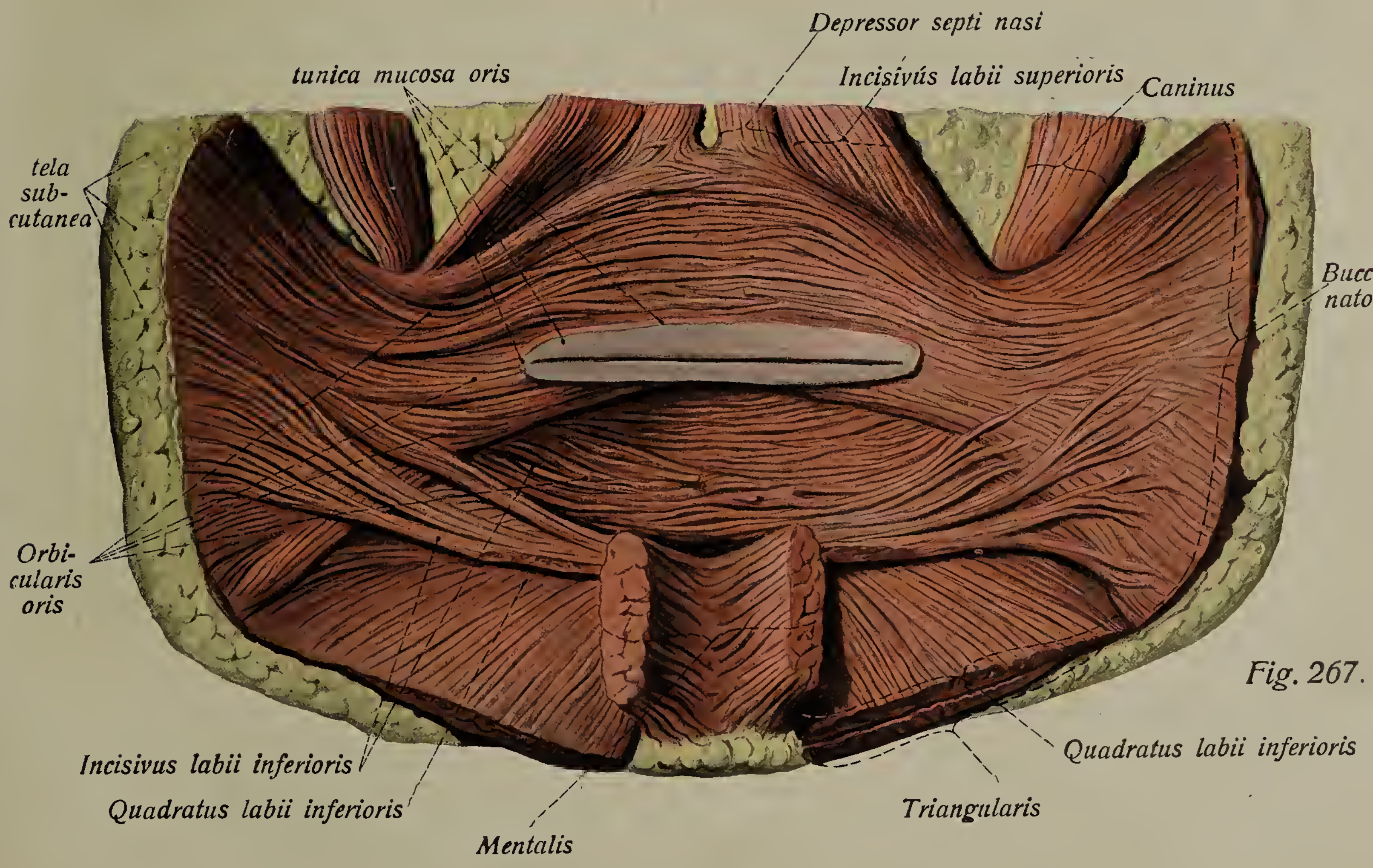


Fig. 267.

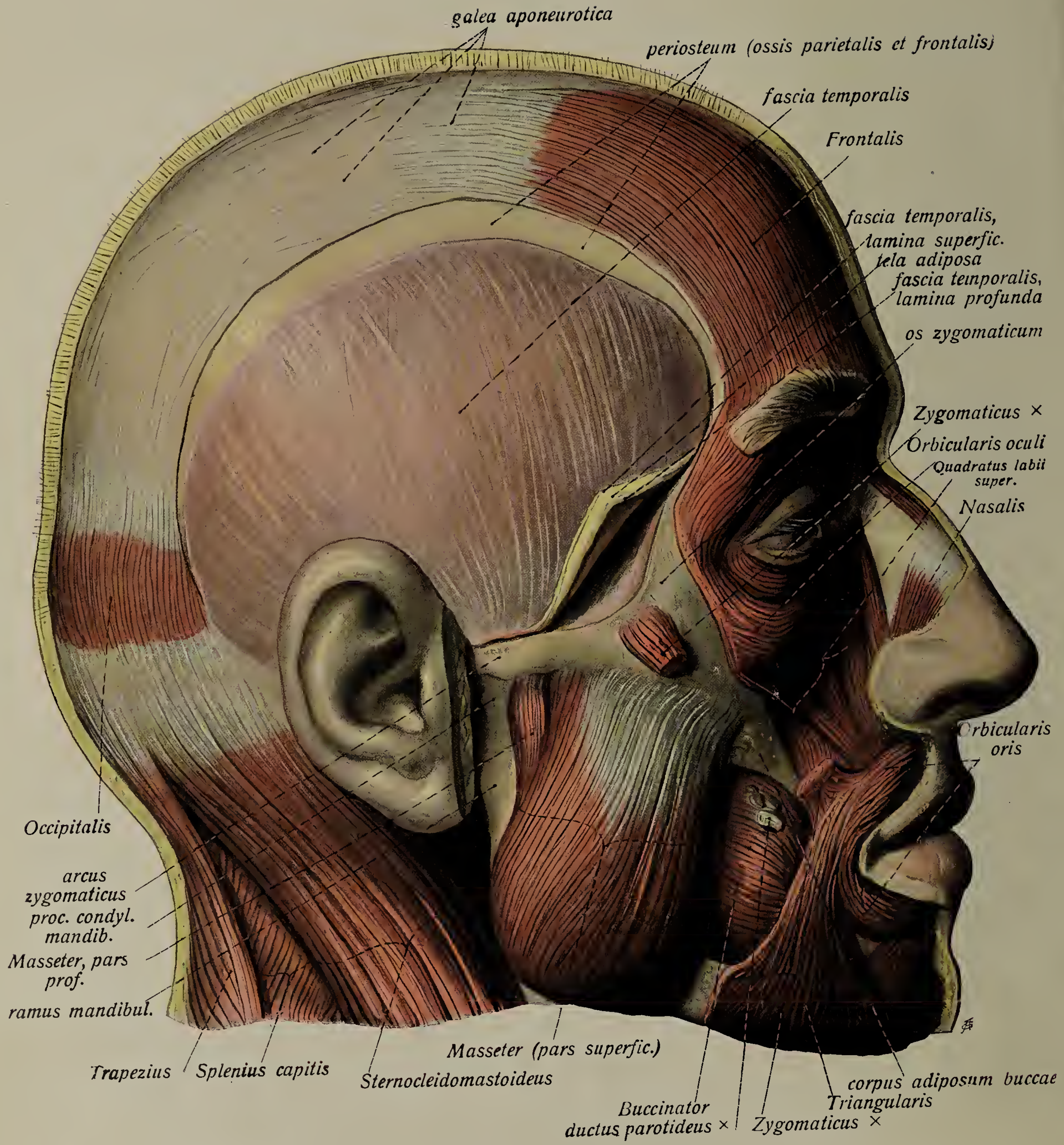

galea aponeurotica
periosteum (ossis parietalis et frontalis)
fascia temporalis
Frontalis
fascia temporalis,
lamina superfic.
tela adiposa
fascia temporalis,
lamina profunda
os zygomaticum
Zygomaticus ×
Orbicularis oculi
Quadratus labii super.
Nasalis
Orbicularis oris
Occipitalis
arcus zygomaticus
proc. condyl. mandib.
Masseter, pars prof.
ramus mandibul.
Trapezius
Splenius capitis
Sternocleidomastoideus
Masseter (pars superfic.)
Buccinator
ductus parotideus ×
Zygomaticus ×
corpus adiposum buccae
Triangularis

Fig. 268.

The Muscles of the Head. (Cont.)

The Muscles of Mastication. (Cont.)

Fig. 268. The masseter, buccinator and temporal fascia from the right side. ($^4/_5$)
The parotid gland and duct and also the buccal fat pad have been removed; the epicranial aponeurosis is cut along the temporal line and the temporal fascia at the upper border of the zygoma is cut and turned upwards.

The Fasciae of the Head and Neck.

Over the vault of the skull there is no fascia, since the galea aponeurotica is directly connected with the deeper layers of the skin.

The *parotideo-masseteric fascia* is a sheet that passes over the parotid gland and the masseter muscle. At the zygoma it is continuous with the temporal fascia, at the anterior border of the masseter with the bucco-pharyngeal and at the angle of the mandible with the cervical (Fig. 264).

The *temporal fascia* is the strongest fascia of the head. It extends as a dense membrane from the superior temporal line to the zygoma and at about the middle of its course it splits into two laminae, a superficial and a deep, between which there is some fat tissue. The interval between the two laminae increases downwards, the superficial lamina inserting into the anterior and the deep into the posterior border of the zygoma. At its upper edge it is connected with the galea aponeurotica.

The *bucco-pharyngeal fascia* rests in its anterior part on the buccinator muscle and is connected with the parotideo-masseteric fascia; its posterior part is stronger and covers the inner surface of the internal pterygoid muscle. It is in this that the *pterygo-mandibular raphe* and *stylo-mandibular ligament* are developed. This posterior part of the fascia bounds the lateral posterior wall of the mouth cavity and the lateral wall of the pharynx (see Vol. II).

In the neck the *fascia colli (cervical fascia)* and the *praevertebral fascia* may be distinguished. The former is divided into a superficial and a deep lamina, this latter being sometimes termed the middle layer. The former covers the superficial muscles of the neck and also the larynx, trachea and submaxillary gland, but is of variable strength in its different parts, being very thin over the lateral surface of the sternomastoid. At the anterior border of the trapezius it passes into the fascia of the back of the neck. The deep lamina covers the omohyoid and the posterior surfaces of the other infrahyoid muscles and, anterior to the larynx and trachea, becomes continuous with the superficial lamina. The quite distinct praevertebral fascia covers the anterior surface of the praevertebral muscles and the bodies of the cervical vertebrae, where these are uncovered by muscles.

The Muscles of the Head. (Cont.)

II. The Muscles of Mastication.

The **Masseter** arises by its superficial fibres from the lower border of the zygoma, by its deeper fibres from the posterior part of the lower border and from the inner surface of the zygoma. It is inserted into the lateral surface of the ramus of the mandible from the mandibular notch to the angle (masseteric tuberosity). *Nerve:* The masseteric nerve from the third division of the trigeminus. *Action:* Closes the jaws.

The **Temporalis** arises from the temporal fossa, below the inferior curved line, and from the deep lamina of the temporal fascia. It inserts into the apex and medial surface of the coronoid process of the mandible. *Nerves:* The deep temporal nerves from the third division of trigeminus. *Action:* Closes the jaws.

The **Pterygoideus externus** arises by its chief head from the lateral surface of the lateral plate of the pterygoid process and from the tuberosity of the maxilla; by its accessory head from the infratemporal crest of the greater wing of the sphenoid. It is inserted into the pterygoid fovea on the condyloid process of the mandible and into the articular disk of the mandibular articulation. *Nerve:* The external pterygoid from the third division of the trigeminus. *Action:* Draws the mandible forward. By the alternate action of the two muscles lateral movements of the mandible are produced.

The **Pterygoideus internus** arises from the pterygoid fossa, from the pyramidal process of the palatine and from the medial surface of the lateral plate of the pterygoid process. It inserts into the medial surface of the angle of the mandible (pterygoid tuberosity). *Nerve:* The internal pterygoid from the third division of the trigeminus. *Action:* Closes the jaws.

Fig. 269. The temporalis and buccinator of the right side. ($^{4}/_{5}$)
The zygoma has been cut away, and the masseter, except in its lowest part, and the temporal fascia have been removed. Otherwise as in Fig. 268.

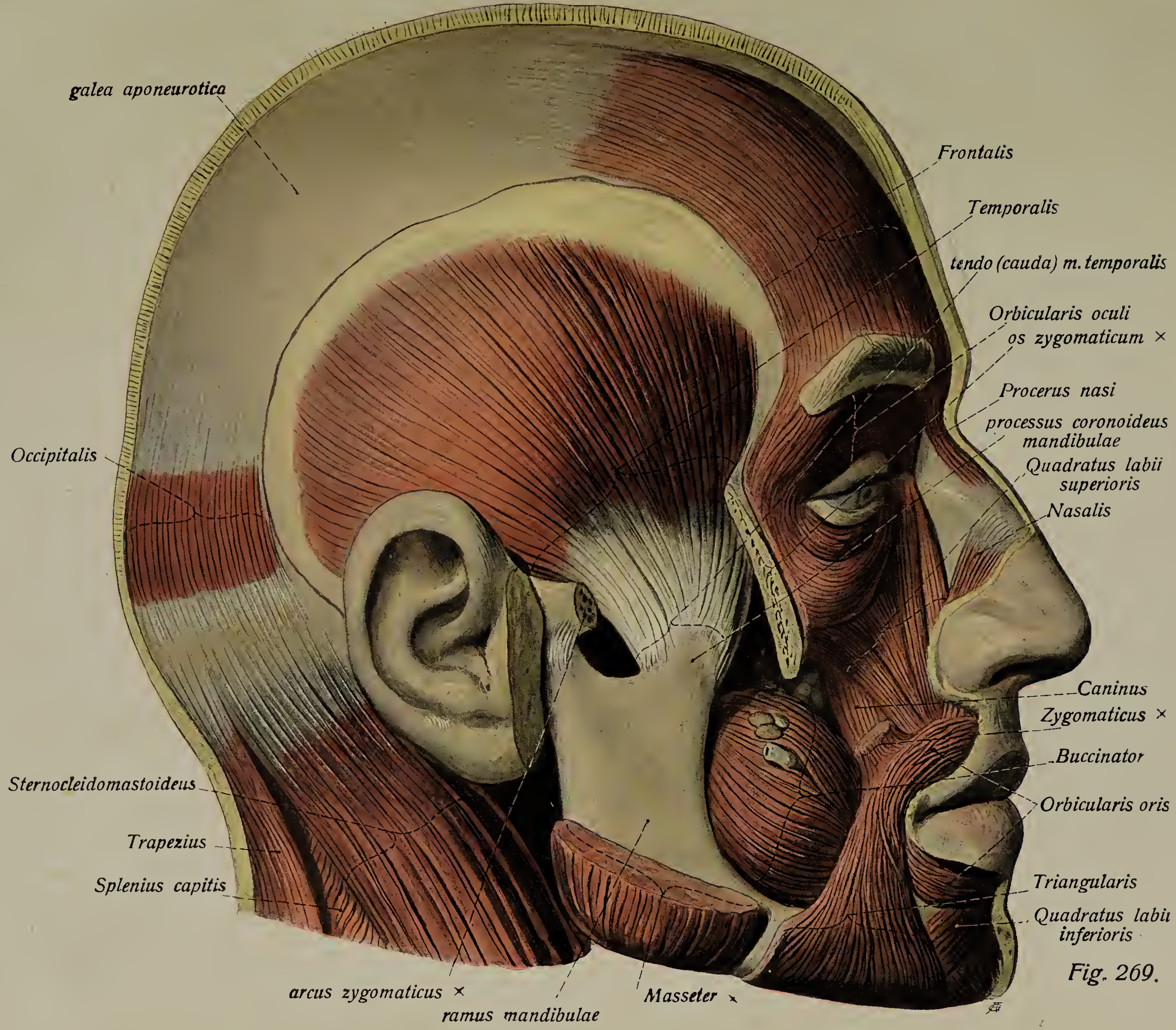

galea aponeurotica
Occipitalis
Sternocleidomastoideus
Trapezius
Splenius capitis
arcus zygomaticus ×
ramus mandibulae
Masseter ×
Frontalis
Temporalis
tendo (cauda) m. temporalis
Orbicularis oculi
os zygomaticum ×
Procerus nasi
processus coronoideus mandibulae
Quadratus labii superioris
Nasalis
Caninus
Zygomaticus ×
Buccinator
Orbicularis oris
Triangularis
Quadratus labii inferioris

Fig. 269.

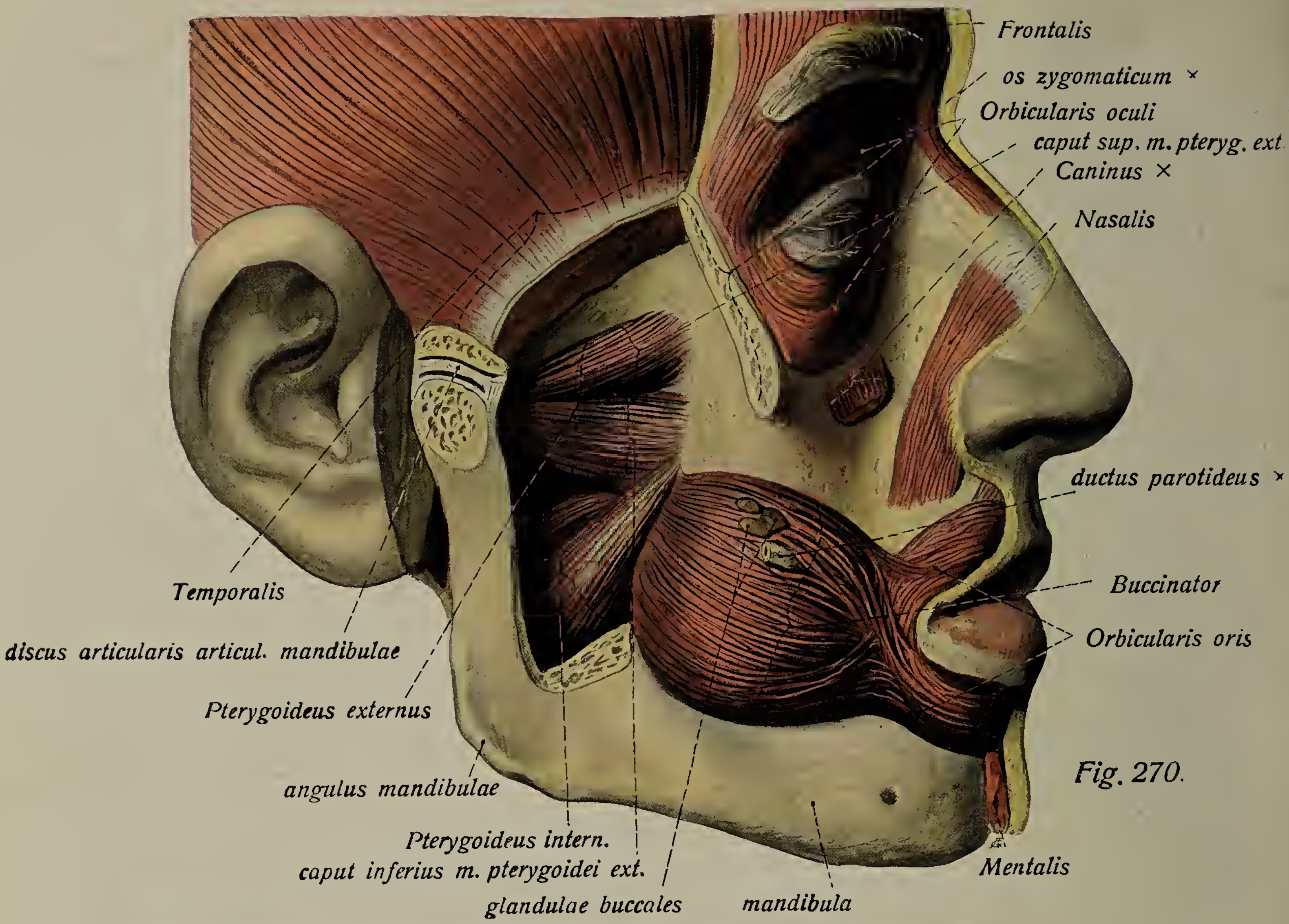


Fig. 270.

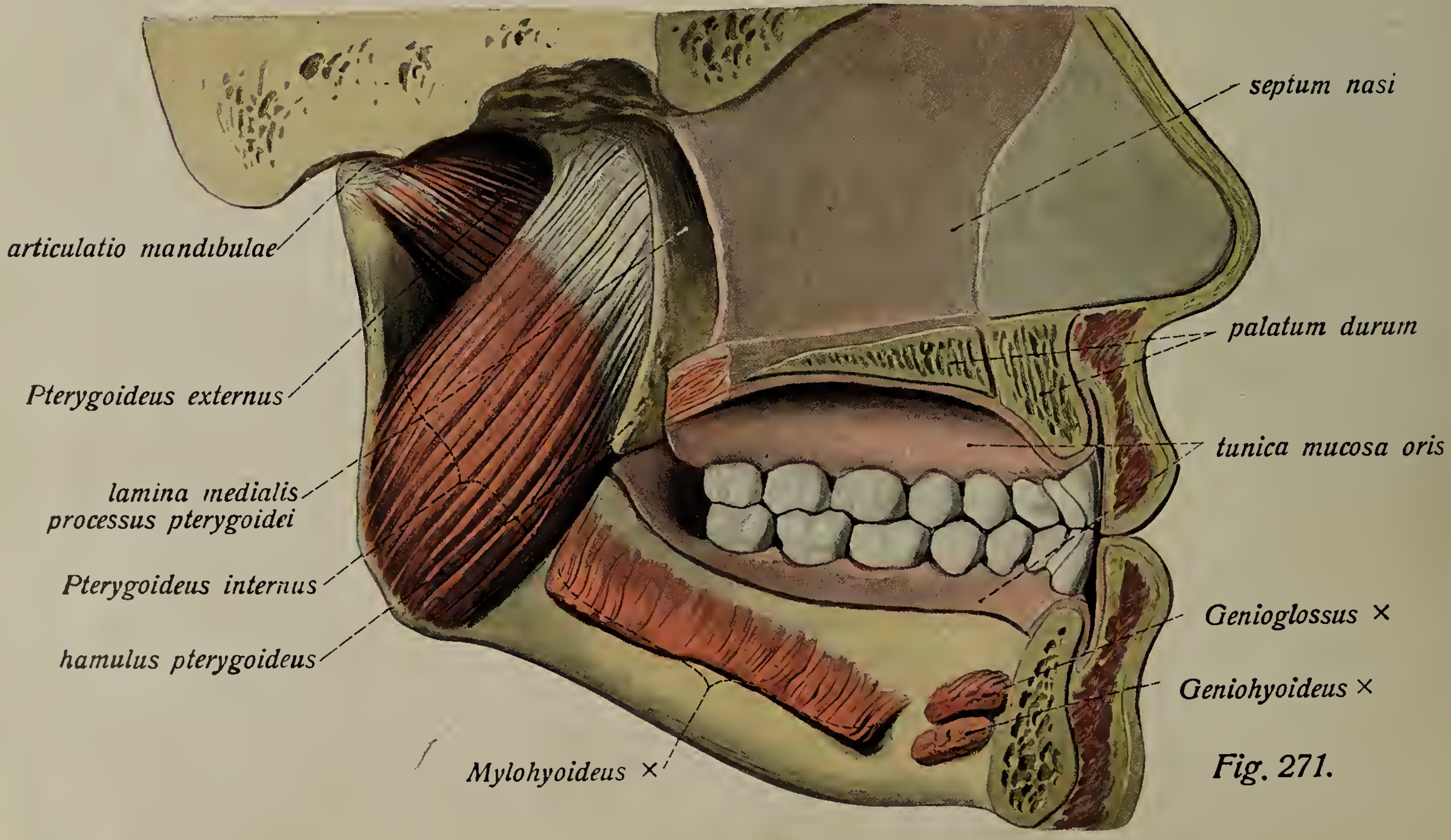


Fig. 271.

The Muscles of the Head. The Muscles of Mastication. (Cont.)

Fig. 270. The right pterygoids and buccinator from the side. ($^4/_5$)

The mandibular joint is opened and part of the ramus cut away.

Fig. 271. The pterygoids from their medial surface. ($^4/_5$)

The head is divided in the median line, the tongue is removed and the soft palate cut away at its root.

The Muscles of the Upper Extremity.

Eleven trunk muscles are attached to the skeleton of the upper extremity, especially to the shoulder girdle. They are:

Neck	1. *Sternocleidomastoideus*, clavicular head (sternal end of clavicle).
	2. *Omohyoideus* (upper border of scapula).
Thorax	1. *Pectoralis major* (crest of greater tuberosity of humerus).
	2. *Pectoralis minor* (coracoid process of scapula).
	3. *Serratus anterior* (vertebral border and inferior angle of scapula).
	4. *Subclavius* (acromial end of clavicle).
Back	1. *Trapezius* (acromial end of clavicle, acromion and spine of scapula).
	2. *Rhomboideus major* (vertebral border of scapula).
	3. *Rhomboideus minor* (vertebral border of scapula).
	4. *Levator scapulae* (medial angle of scapula).
	5. *Latissimus dorsi* (crest of lesser tuberosity of humerus).

The actual muscles of the upper extremity fall into four principal groups.

I. The **shoulder muscles,** which arise from the shoulder girdle and are inserted into the skeleton of the free extremity not far from the girdle. Deltoideus, Supraspinatus, Infraspinatus, Teres minor, Subscapularis and Teres major.

II. The **upper arm muscles,** which, for the greatest part of their course, lie in the upper arm. They are 1. the muscles of the flexor surface (Biceps, Coracobrachialis, Brachialis), and 2. those of the extensor surface (Triceps).

III. The **forearm muscles,** which, for the greatest part of their course, lie in the forearm. They fall into three groups. 1. those of the flexor surface, 2. those of the radial side of the forearm and 3. those of the extensor surface. In the first group the muscles are in two layers; a superficial (Pronator teres, Palmaris longus, Flexor carpi radialis, Flexor digitorum sublimis, Flexor carpi ulnaris) and a deep (Flexor digitorum profundus, Flexor pollicis longus, Pronator quadratus). The radial group includes the Brachio-radialis, Extensor carpi radialis longus and Extensor carpi radialis brevis.

Among the muscles of the extensor surface the Supinator and Anconaeus have a special position. The rest fall into a superficial layer (Extensor digitorum communis, Extensor digiti quinti proprius and Extensor carpi ulnaris), a deep oblique layer (Abductor pollicis longus and Extensor pollicis brevis) and a deep straight layer (Extensor pollicis longus and Extensor indicis proprius.

IV. The hand muscles, which arise from and also insert into the bones of the hand. They may be grouped as 1. the thenar muscles or muscles of the ball of the thumb (Abductor pollicis brevis, Flexor pollicis brevis, Opponens pollicis and Adductor pollicis; 2. the hypothenar or muscles of the ball of the little finger (Abductor digiti quinti brevis, Flexor digiti quinti brevis and Opponens digiti quinti); 3. four Lumbricales; and 4. seven Interossei (4 dorsal and 3 volar). In addition there is a Palmaris brevis, a skin muscle of the volar surface.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Shoulder.

Fig. 272. The muscles of the posterior surface of the left scapula and the adjacent part of the extensor surface of the upper arm. (½)

The deltoid is removed, except at its origin and insertion; only stumps are left of the dorsal and pectoral muscles that are attached to the scapula and humerus.

* = lateral and ** = medial axillary formina.

Fig. 273. The muscles of the anterior surface of the left scapula and the adjacent part of the flexor surface of the upper arm. (½)

Stumps of the attached thoracic, cervical and dorsal muscles are shown.

* = Medial axillary foramen; + = coraco-brachialis; + short head of biceps; + + = long head of triceps.

The **Supraspinatus** arises from the supraspinous fossa of the scapula and is inserted into the upper facet of the greater tuberosity of the humerus. The **Infraspinatus** arises from the lower border of the spine of the scapula, from the infraspinous fossa and the infraspinatus fascia. It inserts into the middle facet on the greater tuberosity of the humerus. *Nerve:* The subscapular from the brachial plexus. *Action:* The supraspinatus abducts the arm; the infraspinatus rotates it outwards.

The **Teres minor** arises from the lower part of the infraspinous fossa, from about two-thirds of the lateral border of the scapula and from the infraspinatus fascia. It inserts into the lower facet of the greater tuberosity of the humerus. *Nerve:* The axillary from the brachial plexus. *Action:* External rotation of the arm.

The **Subscapularis** arises from the subscapular fossa and its muscular lines and inserts by a strong tendon on the lesser tuberosity of the humerus and the upper part of its crest. A *subscapular bursa*, between the tendon and the capsule of the shoulder joint, communicates with the latter. *Nerves:* Subscapular nerves from the brachial plexus. *Action:* Internal rotation of the arm.

The **Deltoid** arises from the acromial third of the clavicle, from the acromion and the spine of the scapula. It is inserted into the deltoid tuberosity of the humerus, a *subdeltoid bursa* being interposed between its tendon and the bone. *Nerve:* The axillary. *Action:* Abducts the arm to the horizontal position.

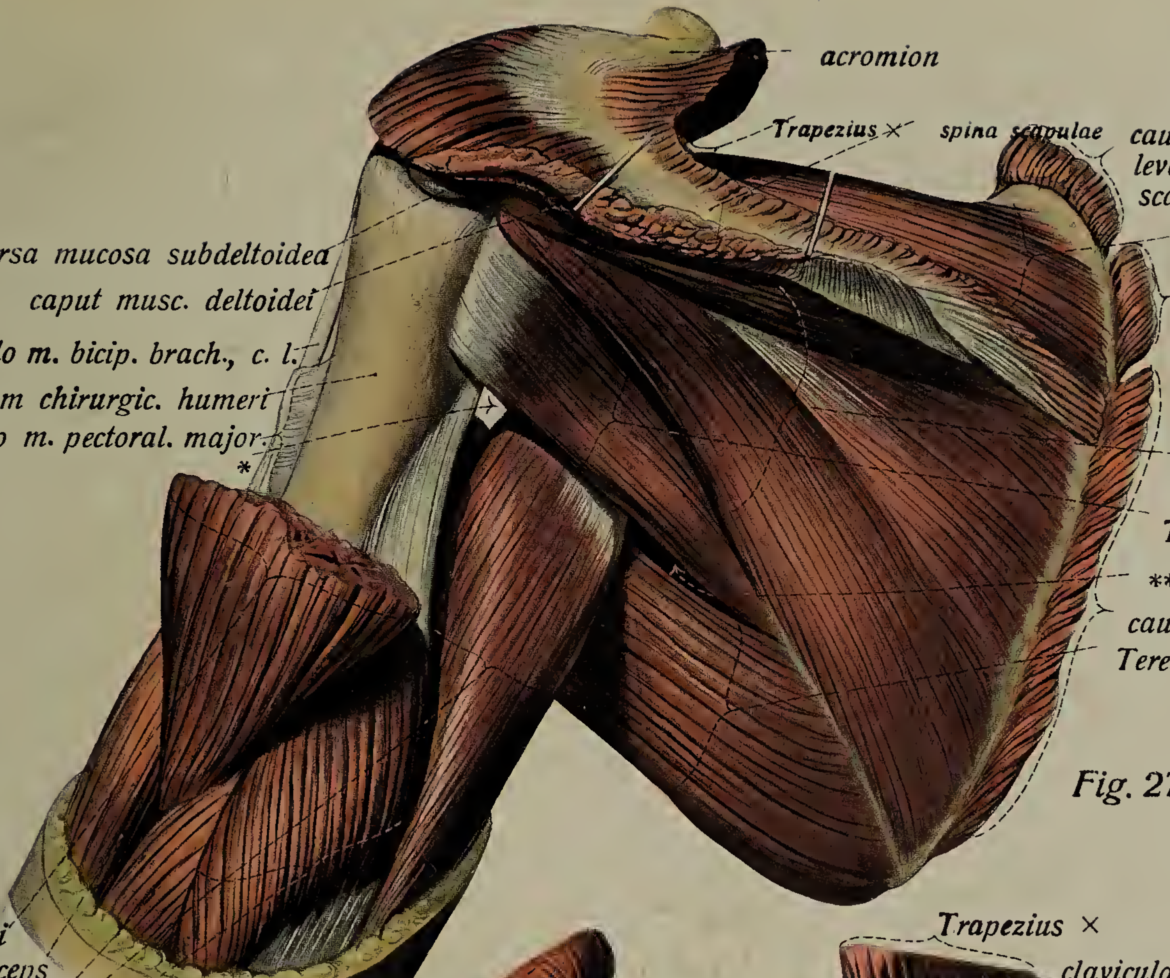


Fig. 272.

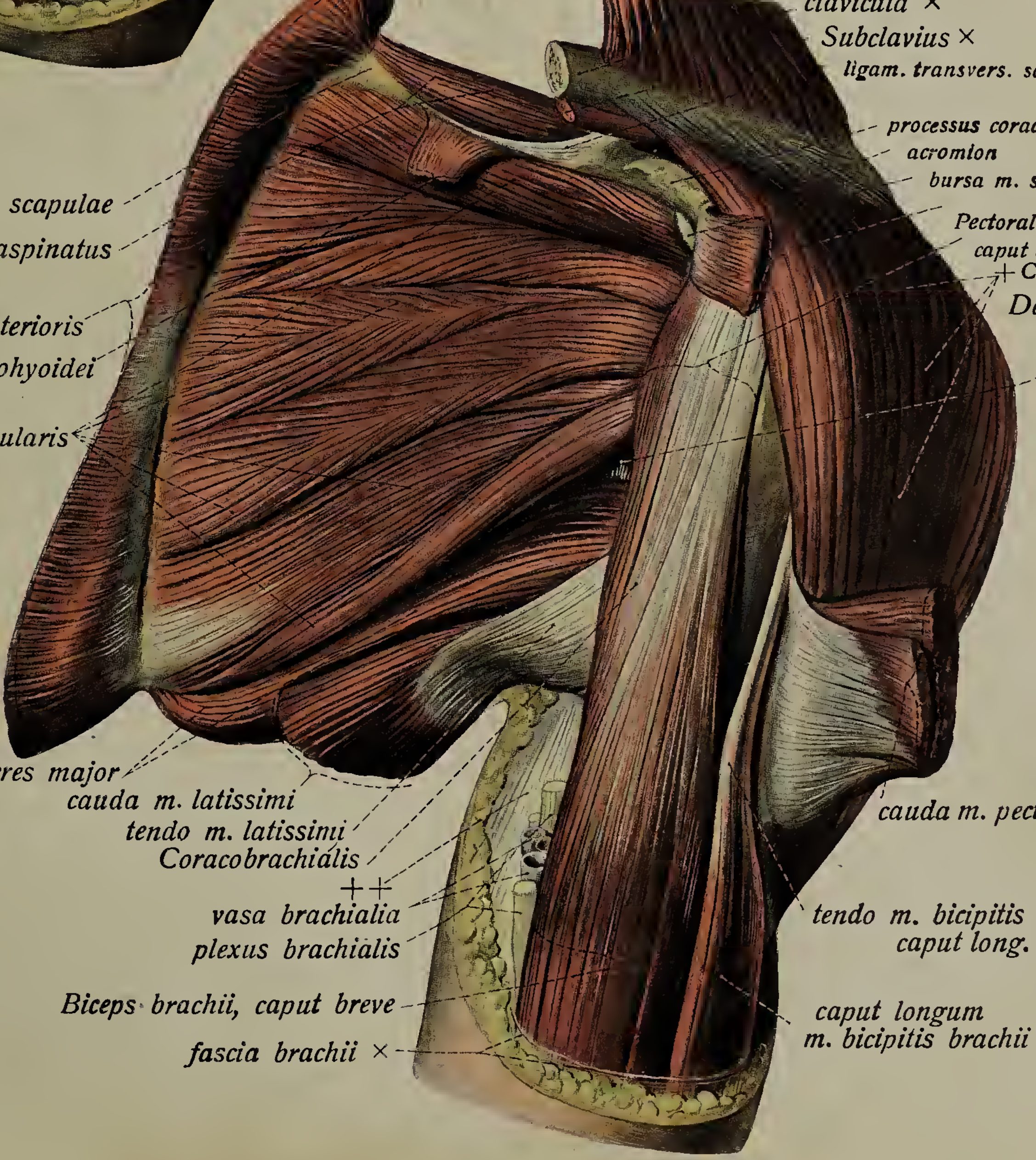


Fig. 273.

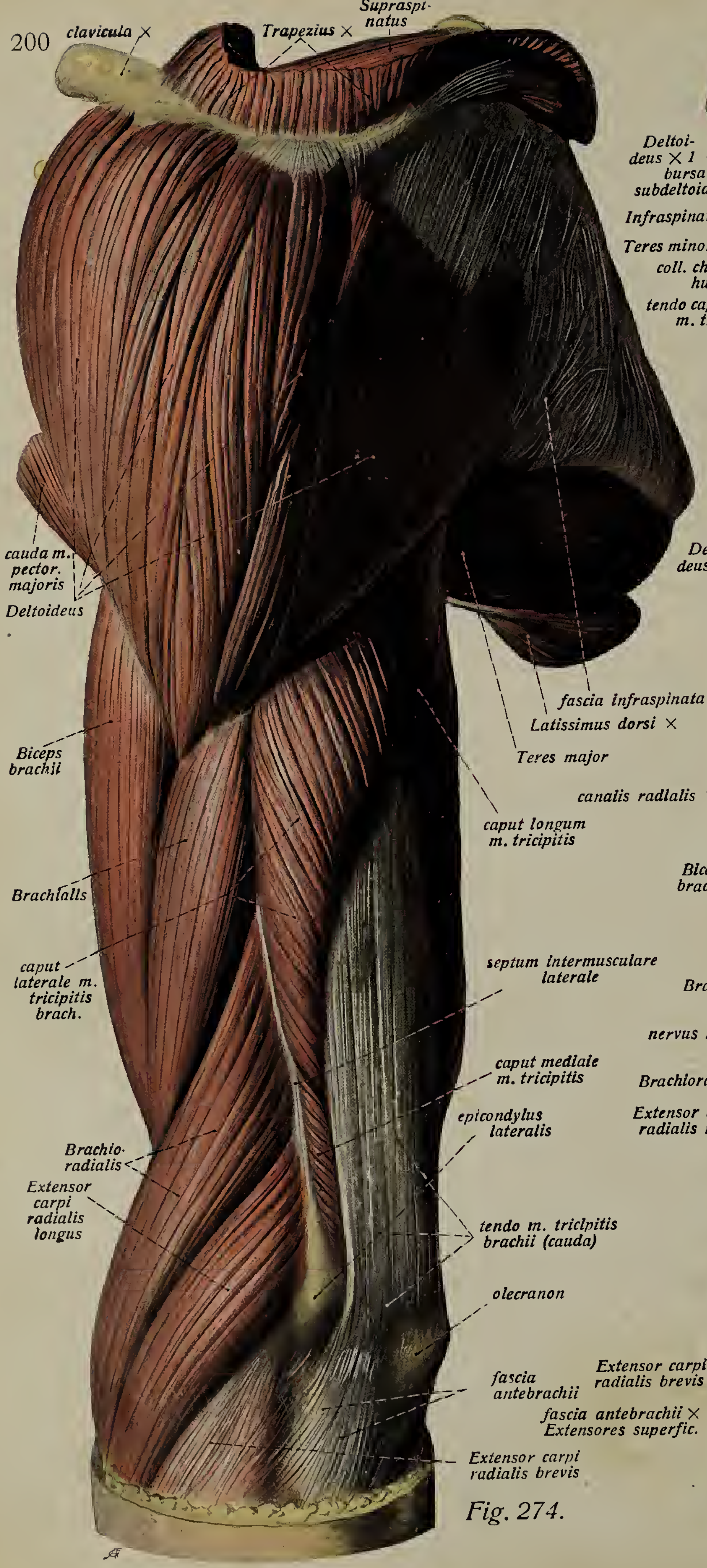

clavicula ×
Trapezius ×
Supraspinatus
cauda m. pector. majoris
Deltoideus
Biceps brachii
Brachialis
caput laterale m. tricipitis brach.
Brachioradialis
Extensor carpi radialis longus
fascia infraspinata
Latissimus dorsi ×
Teres major
caput longum m. tricipitis
septum intermusculare laterale
caput mediale m. tricipitis
epicondylus lateralis
tendo m. tricipitis brachii (cauda)
olecranon
fascia antebrachii
Extensor carpi radialis brevis

Fig. 274.

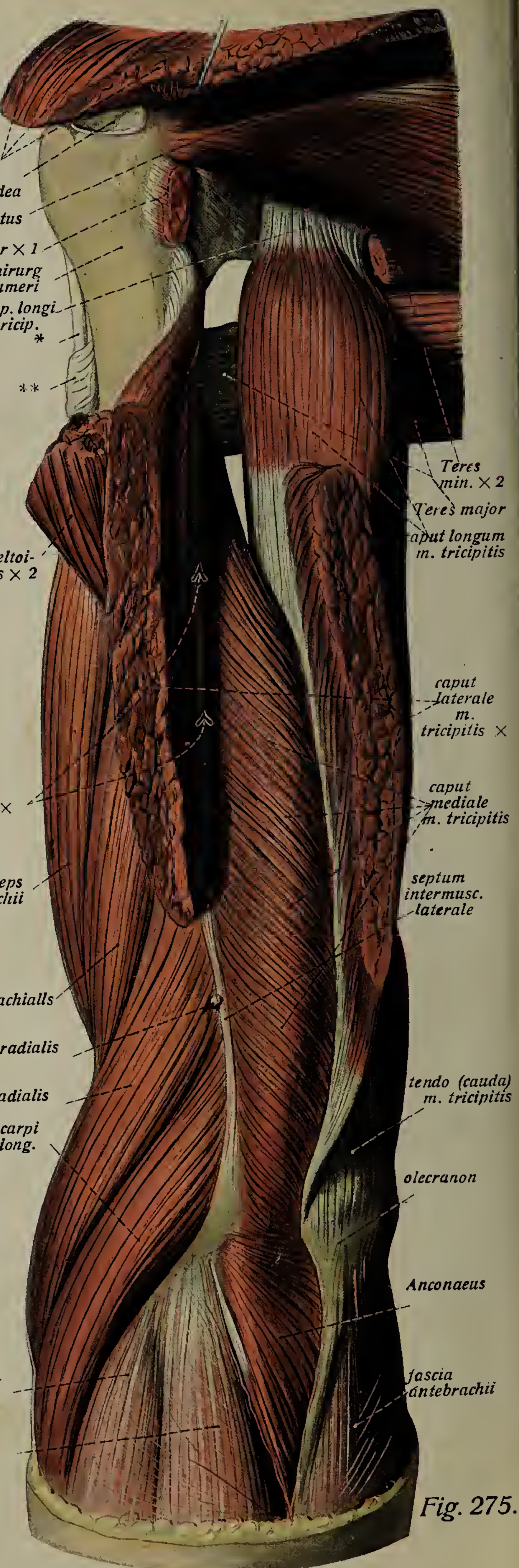


Fig. 275.

The Muscles of the Upper Extremity. (Cont.)

Fig. 274. The deltoid and the muscles of the upper arm from the side and behind. (1/2)

Fig. 275. The deeper layer of the muscles of the upper arm from the side and somewhat from behind. (1/2)

The deltoid is divided and partly removed and the antebrachial fascia is split where it covers the anconaeus. The teres minor and lateral head of the triceps are cut and reflected.

* = tendon of the long head of the biceps; ** = tendon of the pectoralis major.

The Muscles of the Upper Arm.

The Muscles of the Extensor Surface.

The large **Triceps** is the only muscle of the extensor surface of the upper arm, covering its entire surface, and being continued upon the forearm as the anconaeus (see p. 202). It takes origin by three heads. The *long head* arises from the infraglenoid tuberosity of the scapula; the *lateral head* from the lateral and posterior portions of the upper part of the shaft of the humerus, below the greater tuberosity, and also from the upper two-thirds of the lateral intermuscular septum; the *medial head* from the whole length of the medial intermuscular septum down to the medial epicondyle, from the posterior surface of the humerus below the crest of the great tuberosity, following the groove for the radial nerve, and from the lateral intermuscular septum down to the lateral epicondyle. From these three heads the fibres concentrate to a broad tendon that is attached to the posterior part of the upper surface of the olecranon, fibres also passing to the antebrachial fascia.

The **Anconaeus** is in close relation to the lower part of the medial head of the triceps. It arises from the lateral epicondyle of the humerus and inserts into the dorsal surface of the ulna, immediately below the olecranon. *Nerve:* The radial supplies both muscles. *Action:* Extension of the forearm.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Upper Arm. (Cont.) Flexor Surface.

Fig. 276. The superficial layer of the muscles of the flexor surface of the upper arm. (1/2)
* = medial, ** = lateral axillary foramen.

Fig. 277. The deep layer of muscles of the flexor surface of the upper arm. (1/2)
The deltoid and biceps are partly removed. + = common origin of the short head of the biceps and the coraco-brachialis.

The **Biceps brachii** has two heads of origin. The *long head* arises from the supraglenoid tuberosity of the scapula and the *short head* from the tip of the coracoid process. The two heads unite to form a common tendon which is inserted into the tuberosity of the radius and by means of the *lacertus fibrosus* into the antebrachial fascia. A *bicipito-radial bursa* lies between the tendon and the radius. *Nerve:* The musculo-cutaneus. *Action:* Supinates and flexes the forearm; tenses the antebrachial fascia.

The **Coraco-brachialis** arises together with the short head of the biceps from the tip of the coracoid process. It is inserted into the anterior and medial surfaces of the humerus, below the crest of the lesser tuberosity, and into the medial intermuscular septum. *Nerve:* The musculo-cutaneus, which pierces it. *Action:* Aids in raising the arm and in its adduction.

The **Brachialis** arises from the lower parts of the anterior and medial surfaces of the humerus, from the lateral surface below the deltoid tuberosity, and from the medial and lateral intermuscular septa almost down to the epicondyles. It is inserted into the tuberosity of the ulna. *Nerve:* The musculo-cutaneus and frequently also a branch from the radial. *Action:* Flexor of the forearm.

Between the flexor and extensor muscles there is, in the lower portion of the upper arm, on either side an *intermuscular septum.* The stronger medial one ends at the medial epicondyle, the lateral at the lateral epicondyle. They serve for the origin of both groups of .muscles, the lateral also for that of the radial group.

The long head of the triceps passes between the teres major and teres minor and divides the interval between these two muscles into a lateral quadrangular space, through which pass the axillary nerve and the posterior circumflex artery, and a medial triangular one, which gives passage to the circumflex scapular artery.

The medial head at the intermuscular septum adjoins the brachialis and at the medial epicondyle the anconaeus, which continues its fibre-course. The lateral head at the lateral intermuscular septum adjoins from above downwards, the brachialis, the brachio-radialis and sometimes also the extensor carpi radialis longus.

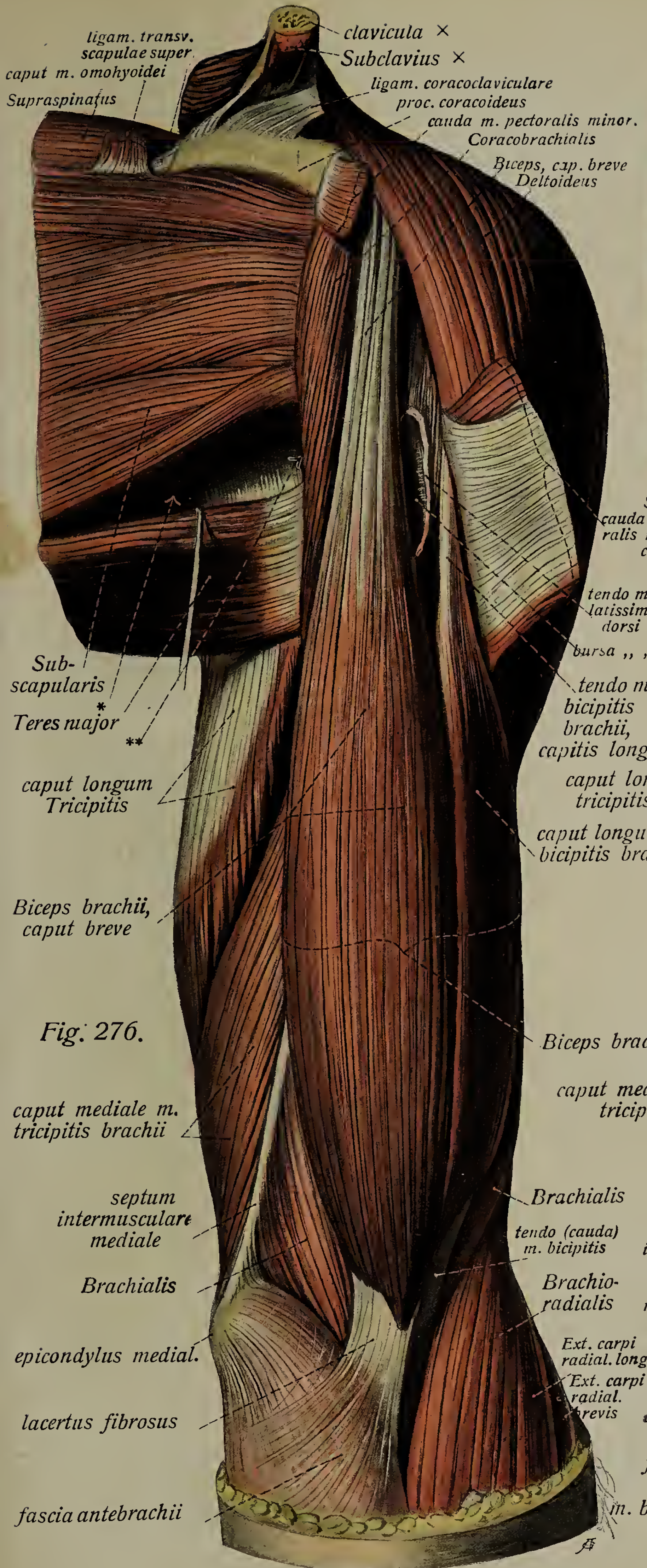


Fig. 276.

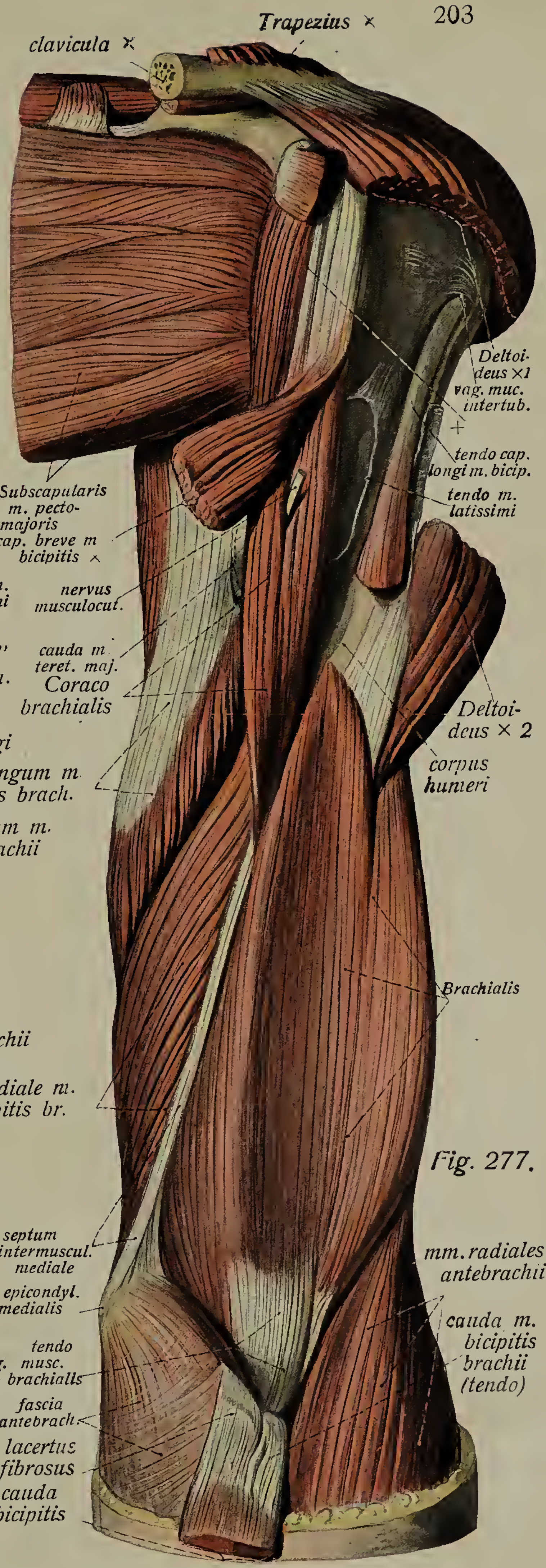


Fig. 277.

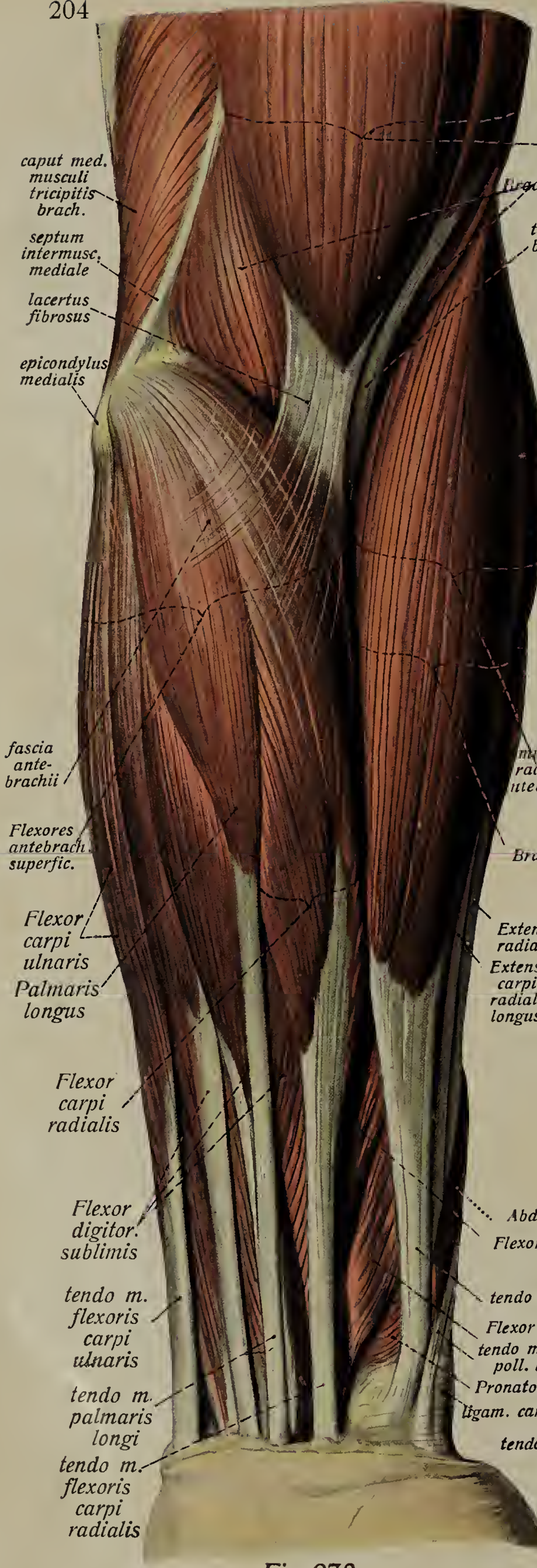


Fig. 278.

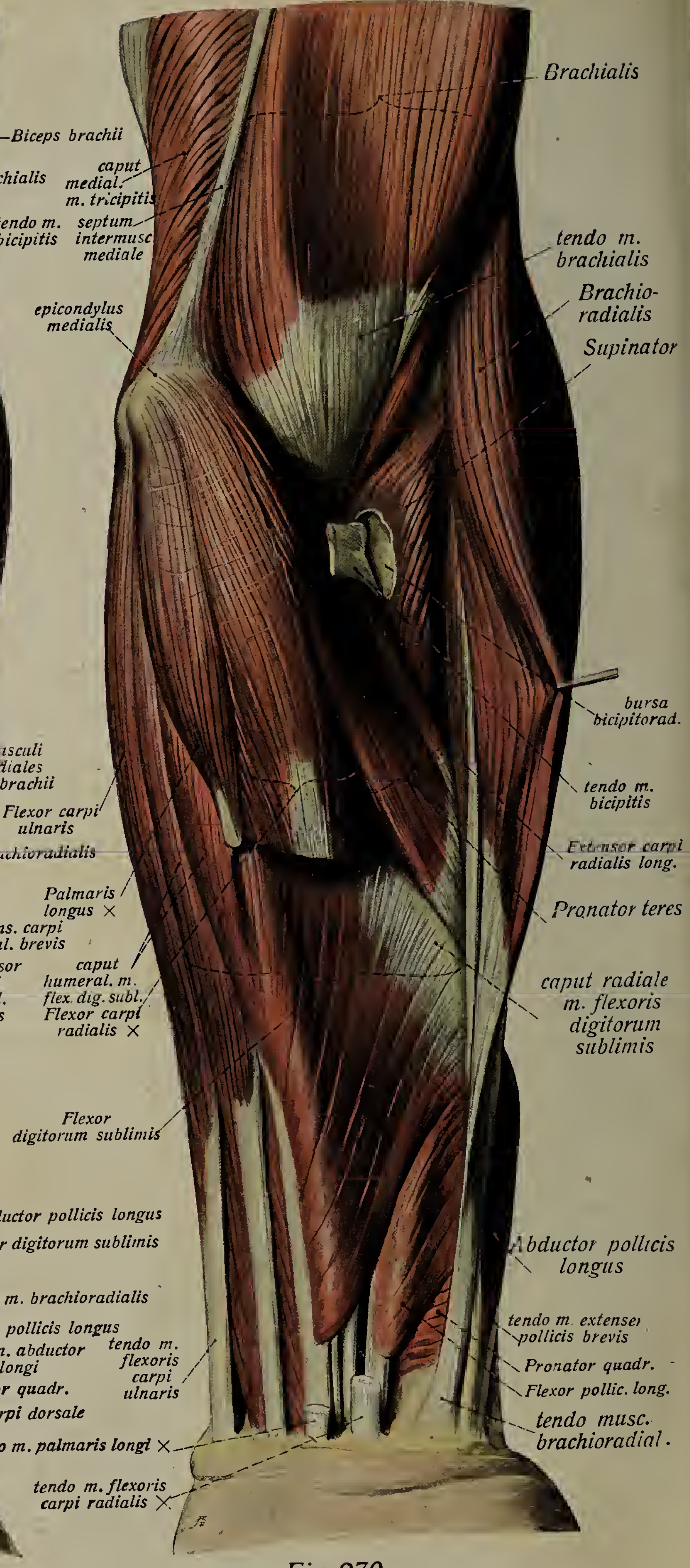

Brachialis
caput medial. m. tricipitis
septum intermusc mediale
epicondylus medialis
tendo m. brachialis
Brachioradialis
Supinator
bursa bicipitorad.
tendo m. bicipitis
Extensor carpi radialis long.
Flexor carpi ulnaris
Pronator teres
Palmaris longus ×
caput humeral. m. flex. dig. subl.
Flexor carpi radialis ×
caput radiale m. flexoris digitorum sublimis
Flexor digitorum sublimis
Abductor pollicis longus
tendo m. extensor pollicis brevis
Pronator quadr.
Flexor pollic. long.
tendo musc. brachioradial.
tendo m. flexoris carpi ulnaris
tendo m. palmaris longi ×
tendo m. flexoris carpi radialis ×

Fig. 279.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Forearm. Superficial Layer of Flexors.

Fig. 278. The superficial layer of the flexor muscles of the forearm and the brachio-radialis from in front. ($^2/_3$)

Fig. 279. The same after division of the palmaris longus and flexor carpi radialis. ($^2/_3$) The brachio-radialis is drawn laterally to show the supinator and the insertion of the biceps tendon; the bicipito-radial bursa is opened.

The superficial layer of the flexor muscles of the forearm arises by a common tendon from the medial epicondyle of the humerus. All the muscles of the group, except the pronator teres, pass over the wrist joint and have more or less long tendons. They occupy the ulnar side of the volar surface of the forearm and in their upper portions are firmly attached to the antebrachial fascia. A deep furrow separates them above from the muscles of the radial group, and in this groove the biceps tendon descends to its insertion.

The **Pronator teres** arises by a *humeral head* from the medial epicondyle of the humerus and the antebrachial fascia and by an *ulnar head* from the coronoid process of the ulna. It inserts into the middle of the lateral surface of the radius. *Nerve:* Median, which passes between the two heads. *Action:* Pronation; assists also in flexion.

The **Flexor carpi radialis** arises from the medial epicondyle and the antebrachial fascia and is inserted into the volar surface of the base of the second metacarpal. *Nerve:* Median. *Action:* Volar flexion and radial abduction.

The **Palmaris longus** is not always present. It arises from the medial epicondyle and the antebrachial fascia and inserts into the palmar aponeurosis and the transverse carpal ligament. *Nerve:* Median. *Action:* Tenses the palmar aponeurosis and assists in flexion.

The **Flexor digitorum sublimis** arises from the medial epicondyle by a *humeral head* and from the volar surface and volar border of the radius by a *radial head*. It is inserted by four long tendons into the middle phalanges of the second to the fifth fingers. *Nerve:* Median. *Action:* Flexes the middle phalanges of the fingers.

The **Flexor carpi ulnaris** arises by a *humeral head* from the medial epicondyle and by an *ulnar head* from the olecranon and, through the antebrachial fascia, from the upper two-thirds of the posterior border of the ulna. It inserts into the pisiform bone and, by means of the ligaments of that bone (Fig. 207), to the base of the fifth metacarpal. *Nerve:* Ulnar. *Action:* Volar flexion and ulnar abduction.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Forearm. Deep Layer of Flexors. (Cont.)

Fig. 280. The middle layer of the muscles of the flexor surface of the forearm. ($^{2}/_{3}$)
The pronator teres, flexor carpi radialis and palmaris longus have been removed to expose the flexor digitorum sublimis. The edge of the brachio-radialis is drawn laterally.
+* = cut surface of the removed muscles.

Fig. 281. The deep layer of the muscles of the flexor surface of the forearm. ($^{2}/_{3}$)
All superficial flexors, except the flexor carpi ulnaris, have been removed.
* = stump of the ulnar head of the pronator teres; + = stump of the removed superficial flexors. ** = gap in the tendon of the flexor digitorum profundus for the passage of the dorsal interosseous vessels.

The deep layer of the flexor surface of the forearm is almost completely covered by the superficial layer and consists of two deep flexors of the fingers and the pronator quadratus. Strictly speaking it represents two layers; since the two flexors completely cover the pronator quadratus.

The **Flexor digitorum profundus** arises from the volar surface of the ulna and from the interosseous membrane. It divides into four long tendons which pass to the terminal phalanges of the second to the fifth fingers. *Nerve:* Ulnar and, for its radial part, the median also. *Action:* Flexion of the terminal phalanges of the fingers.

The **Flexor pollicis longus** arises by a principal *radial head* from the volar surface of the radius, below the insertion of the supinator, and by an inconstant *humeral head* from the medial epicondyle. It is inserted into the terminal phalanx of the thumb. *Nerve:* The volar interosseous from the median. *Action:* Flexes the terminal phalanx of the thumb.

The **Pronator quadratus** passes across from the volar border of the ulna to the volar border and surface of the radius. *Nerve:* The volar interosseous from the median. *Action:* Pronation.

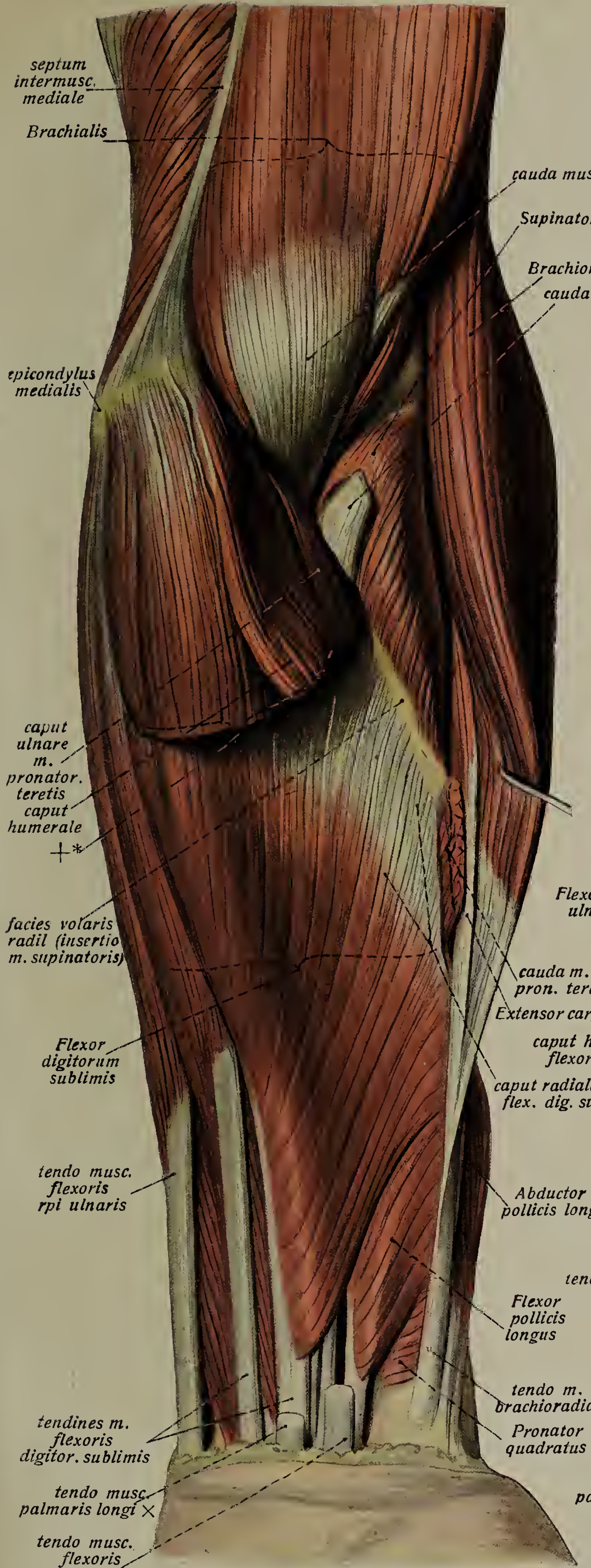

septum intermusc. mediale
Brachialis
cauda musc. brachialis
Supinator
Brachioradialis
cauda m. bicipitis
epicondylus medialis
caput ulnare m. pronator. teretis
caput humerale
+*
facies volaris radii (insertio m. supinatoris)
Flexor digitorum sublimis
tendo musc. flexoris rpi ulnaris
cauda m. pron. teretis.
Extensor carpi rad. long.
caput radiale m. flex. dig. subl.
Abductor pollicis longus
Flexor pollicis longus
tendo m. brachioradialis
Pronator quadratus
tendines m. flexoris digitor. sublimis
tendo musc. palmaris longi ×
tendo musc. flexoris carpi radialis ×

Fig. 280.

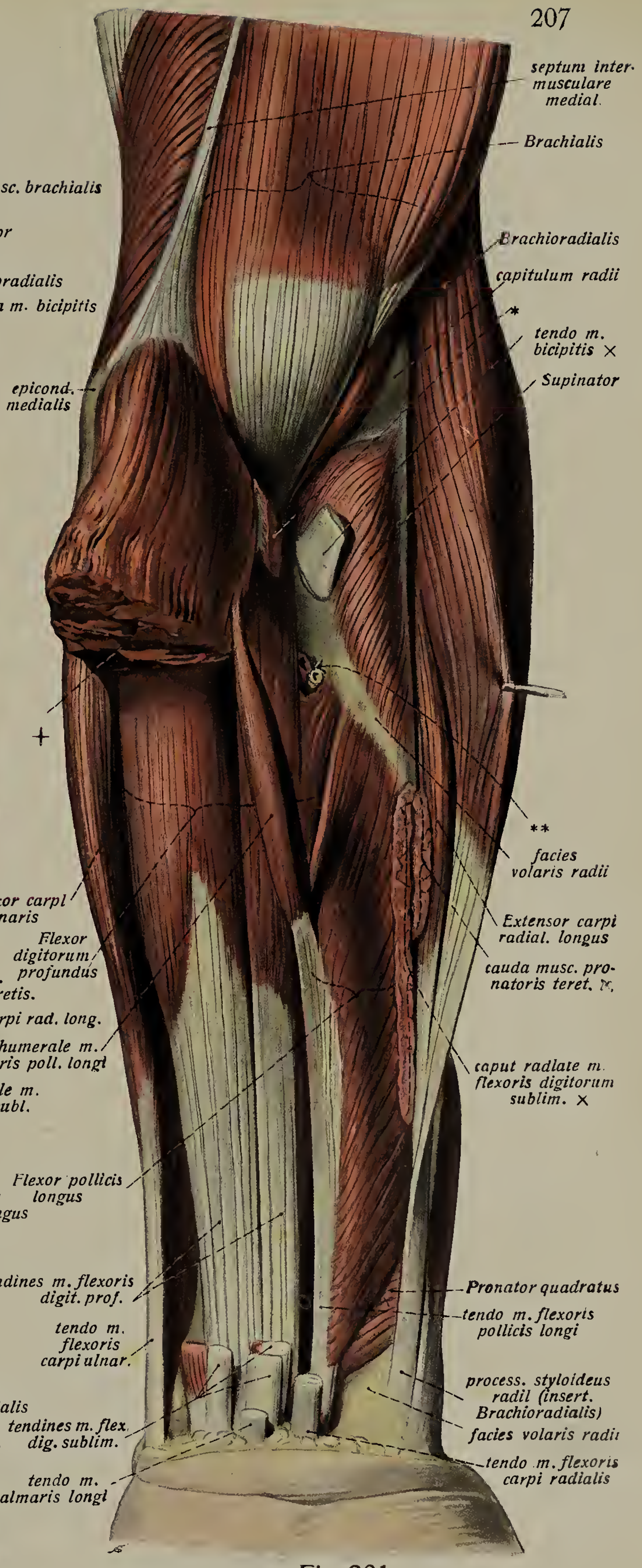

septum inter-musculare medial.
Brachialis
Brachioradialis
capitulum radii
*
tendo m. bicipitis ×
Supinator
epicond. medialis
+
**
facies volaris radii
Extensor carpi radial. longus
cauda musc. pronatoris teret. ×
caput radiale m. flexoris digitorum sublim. ×
Flexor carpi ulnaris
Flexor digitorum profundus
caput humerale m. flexoris poll. longi
Flexor pollicis longus
tendines m. flexoris digit. prof.
Pronator quadratus
tendo m. flexoris pollicis longi
tendo m. flexoris carpi ulnar.
process. styloideus radii (insert. Brachioradialis)
facies volaris radii
tendines m. flex. dig. sublim.
tendo m. flexoris carpi radialis
tendo m. palmaris longi

Fig. 281.

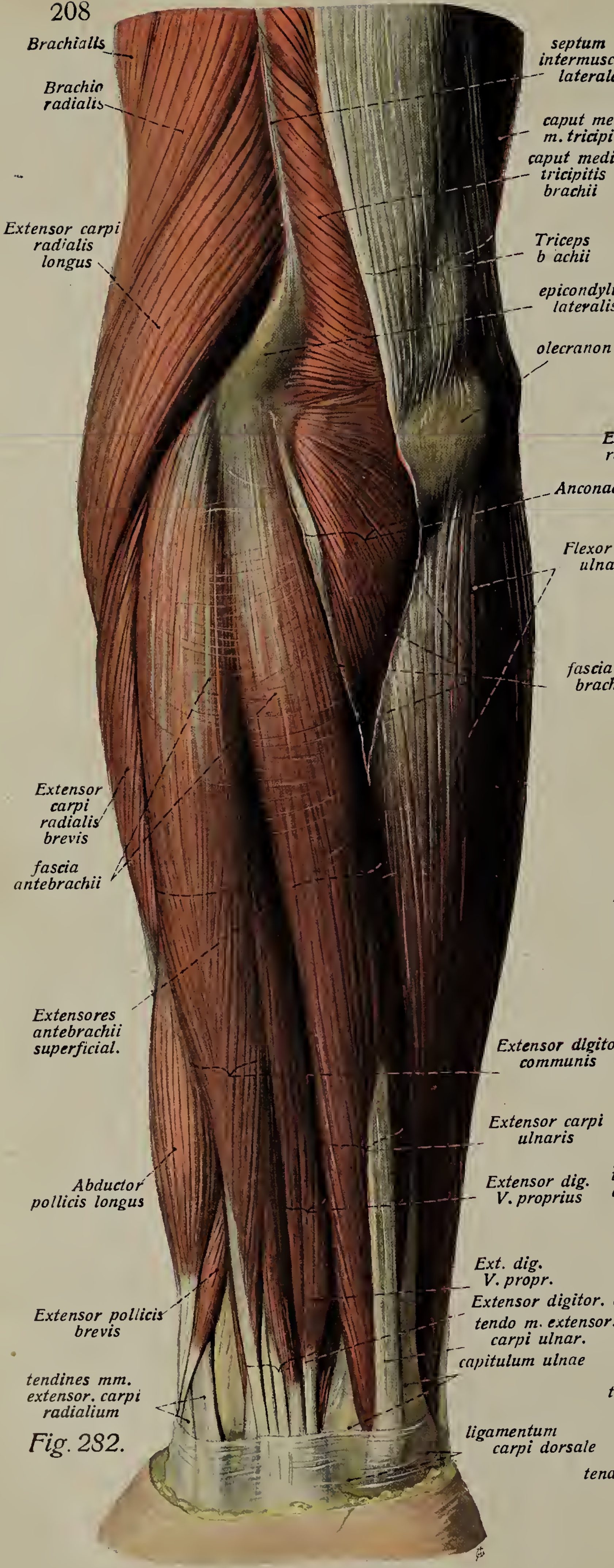


Fig. 282.

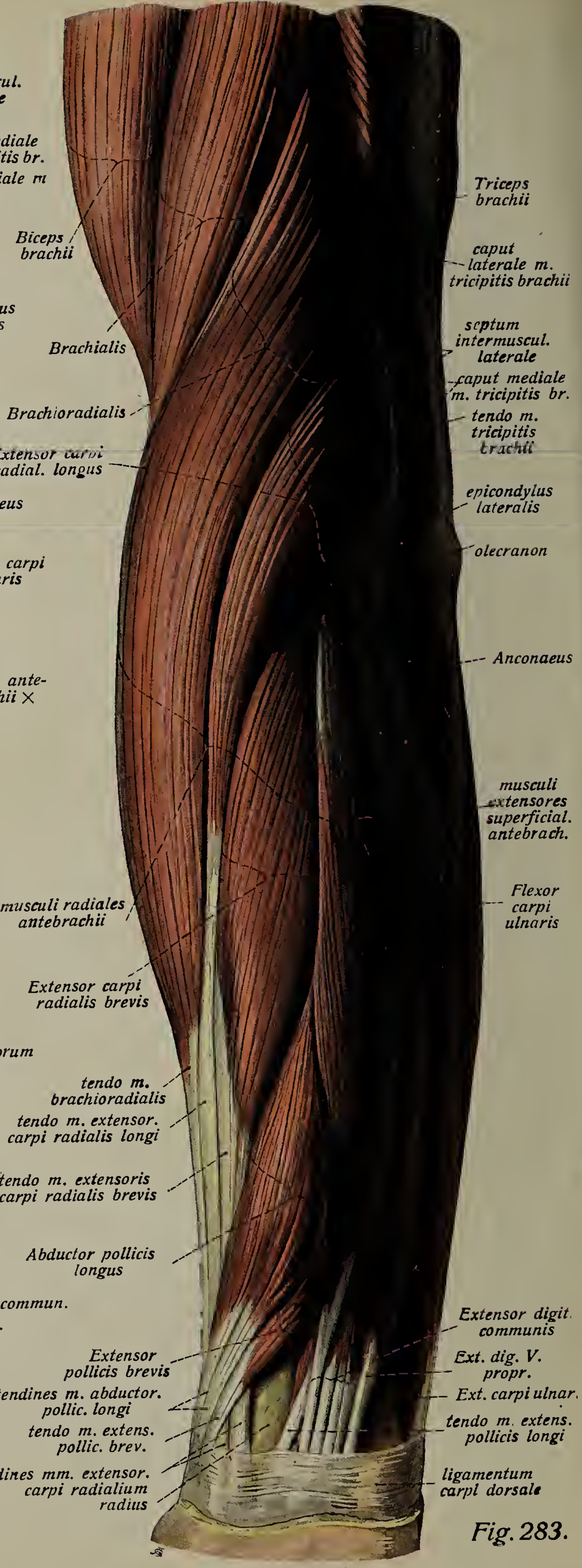


Fig. 283.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Forearm. The Radial and Extensor Groups.

Fig. 282. The superficial muscles of the extensor surface of the forearm, from behind. (1/2)

The portion of the antebrachial fascia over the anconaeus has been removed.

Fig. 283. The superficial muscles of the extensor surface of the forearm, from the radial side. (3/7)

The Muscles of the Radial Group.

The **Brachio-radialis** arises from the lateral border of the humerus and from the lateral intermuscular septum of the upper arm and is inserted by a flat tendon into the upper end of the styloid process of the radius. *Nerve:* The radial (musculo-spiral). *Action:* Flexion of the forearm.

The **Extensor carpi radialis longus** arises from the lower end of the lateral intermuscular septum and the lateral epicondyle of the humerus and inserts into the dorsal surface of the base of the second metacarpal. The **Extensor carpi radialis brevis** arises from the lateral epicondyle of the humerus and from the antebrachial fascia and is inserted into the dorsal surface of the base of the third metacarpal. *Nerve:* The radial (musculospiral). *Action:* The brevis especially gives dorsal flexion of the hand; the longus radial abduction.

The Superficial Layer of Extensors.

The **Extensor communis digitorum** arises from the lateral epicondyle of the humerus and from the antebrachial fascia. Its four tendons, which are connected by tendinous slips, pass into the dorsal aponeurosis of the second to the fifth digits. The **Extensor digiti quinti proprius** also arises from the lateral epicondyle of the humerus and from the antebrachial fascia and is inserted into the dorsal aponeurosis of the fifth finger. *Nerve:* The deep radial. *Action:* Extend the fingers.

The **Extensor carpi ulnaris** is separated from the two preceding muscles by an intermuscular septum and arises, like them, from the lateral epicondyle of the humerus and from the antebrachial fascia. It is inserted into the dorsal surface of the base of the fifth metacarpal. *Nerve:* The deep radial. *Action:* Dorsal flexion of the hand and ulnar abduction.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Forearm. The Deep Extensor Layer.

Fig. 284. The muscles of the extensor surface of the forearm, from behind. ($^1/_2$)
The extensor digitorum communis and the extensor digiti V proprius are cut away and the tendon sheaths of the dorsal carpal ligament are partly opened.
1 = sheath for the extensor digiti V proprius; 2 = sheath for the extensor digitorum communis; 3 = sheath for the extensor pollicis longus.

Fig. 285. The deep layer of muscles of the extensor surface of the forearm, from behind and radially. ($^1/_2$)
The superficial layer of the extensor and the radial group of muscles have been removed; the tendon sheaths of the dorsal carpal ligament are all opened.
+ = sheath for the abductor pollicis longus and the extensor pollicis longus.
* = sheath for the extensor digiti V proprius.
** = sheath for the extensor communis digitorum and the extensor indicis proprius.

The Deep Oblique Group of Extensors.

The **Abductor pollicis longus** arises from the dorsal surface of the ulna, the interosseous membrane and the dorsal surface of the radius, and is inserted into the base of the metacarpal of the thumb, slips passing to the trapezium (greater multangular) and to the abductor pollicis brevis. The **Extensor pollicis brevis** arises from the dorsal surface of the radius and the interosseous membrane and inserts into the basal phalanx of the thumb. *Nerve:* The deep radial. *Action:* Abduction and flexion of the thumb; abduction of the hand.

The Deep Straight Group of Extensors.

The **Extensor pollicis longus** arises from the dorsal surface of the ulna and the interosseous membrane and is inserted into the terminal phalanx of the thumb. The **Extensor indicis proprius** arises from the same parts and inserts into the dorsal aponeurosis of the index finger. *Nerve:* The deep radial. *Action:* Extension of the thumb or index finger.

The **Supinator** arises from the lateral epicondyle of the humerus, the radial collateral and annular ligaments and the supinator crest of the ulna. It is pierced by the deep radial nerve and so divided into a superficial and a deep layer. It is inserted into the volar surface and border, the lateral surface and dorsal border of the radius, both above and below the tuberosity. *Nerve:* The deep radial. *Action:* Supination.

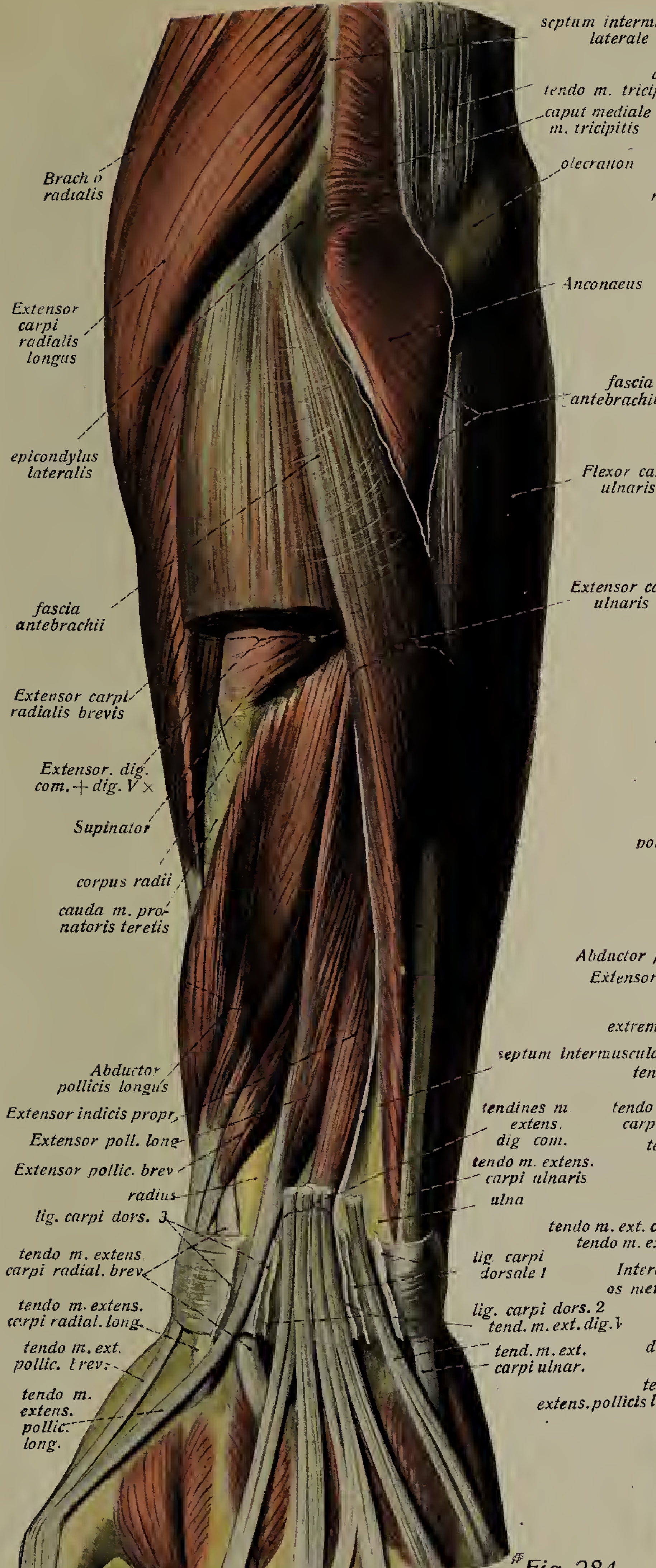

septum intermuscul laterale
tendo m. tricipitis
caput mediale m. tricipitis
olecranon
Brachioradialis
Extensor carpi radialis longus
Anconaeus
fascia antebrachii ×
epicondylus lateralis
Flexor carpi ulnaris
fascia antebrachii
Extensor carpi ulnaris
Extensor carpi radialis brevis
Extensor. dig. com. + dig. V ×
Supinator
corpus radii
cauda m. pronatoris teretis
Abductor pollicis longus
septum intermusculare
Extensor indicis propr.
tendines m. extens. dig com.
Extensor poll. long.
tendo m. extens. carpi ulnaris
Extensor pollic. brev.
radius
ulna
lig. carpi dors. 3
tendo m. extens carpi radial. brev.
lig. carpi dorsale 1
tendo m. extens. carpi radial. long.
lig. carpi dors. 2
tend. m. ext. dig. V
tendo m. ext. pollic. brev.
tend. m. ext. carpi ulnar.
tendo m. extens. pollic. long.

Fig. 284.

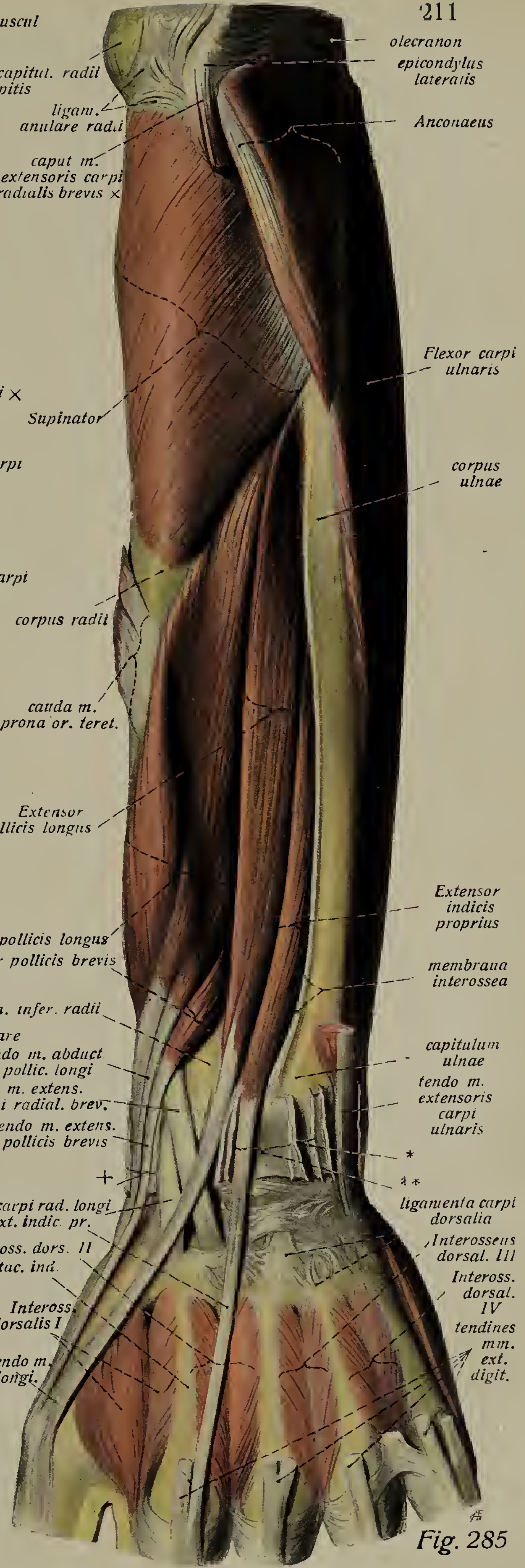


Fig. 285

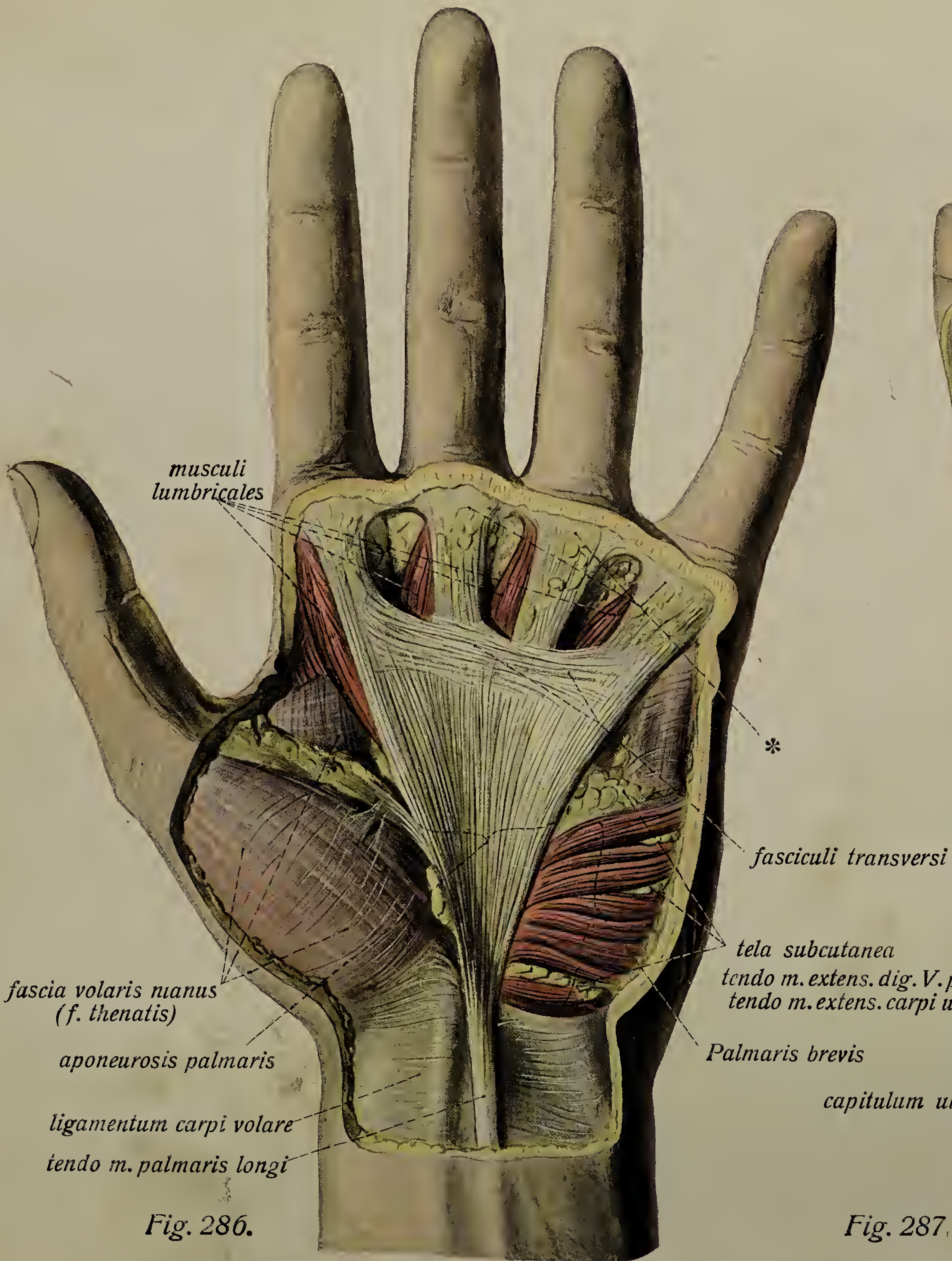


Fig. 286.

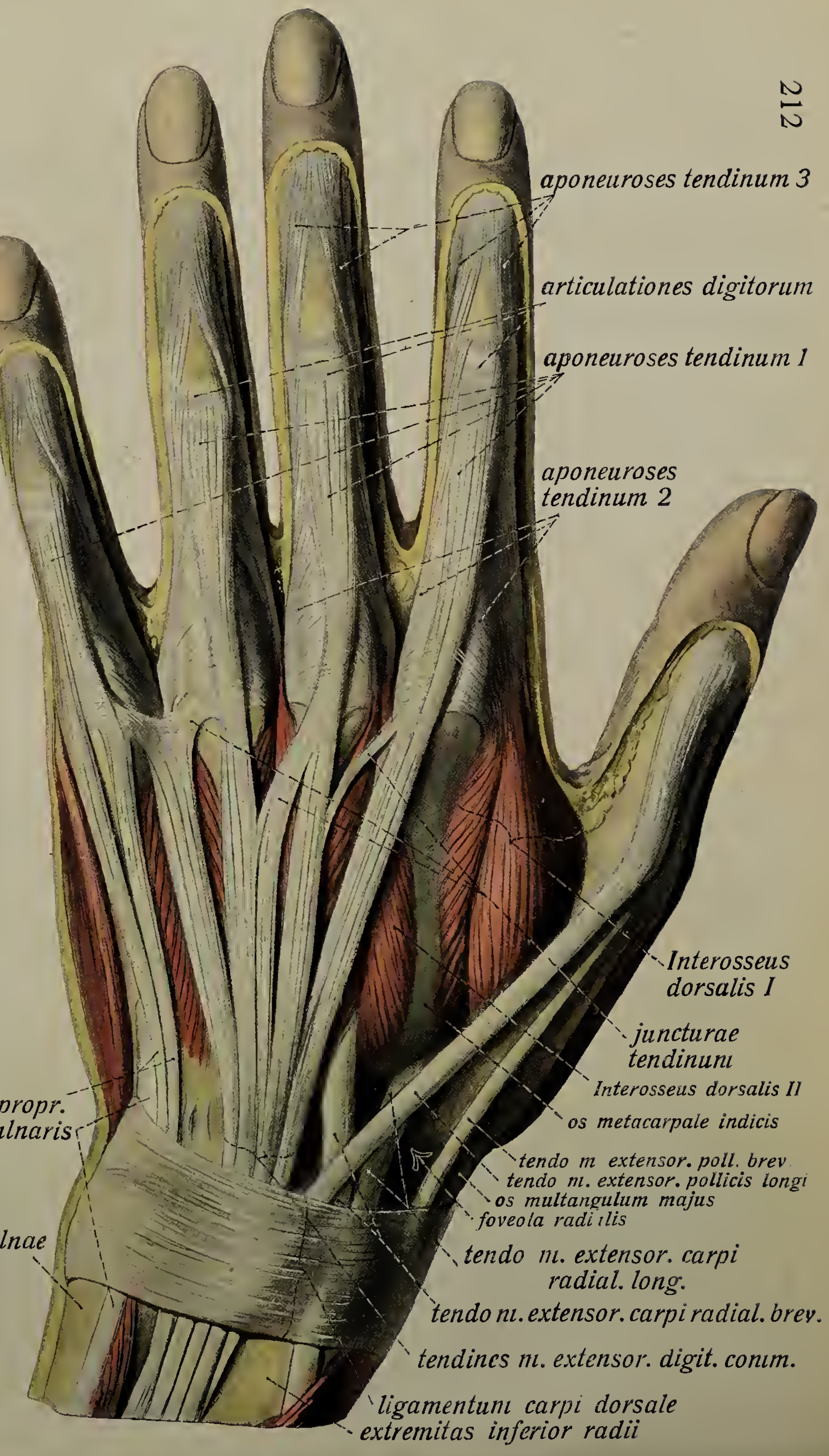

aponeuroses tendinum 3
articulationes digitorum
aponeuroses tendinum 1
aponeuroses tendinum 2
Interosseus dorsalis I
juncturae tendinum
Interosseus dorsalis II
os metacarpale indicis
tendo m extensor. poll. brev.
tendo m. extensor. pollicis longi
os multangulum majus
foveola radialis
tendo m. extensor. carpi radial. long.
tendo m. extensor. carpi radial. brev.
tendines m. extensor. digit. comm.
ligamentum carpi dorsale
extremitas inferior radii
tendo m. extens. dig. V. propr.
tendo m. extens. carpi ulnaris
capitulum ulnae

Fig. 287.

The Muscles of the Hand.

The flexor tendons in the palm of the hand are covered by a strong tendinous membrane, the *palmar aponeurosis,* which is usually the direct expansion of the tendon of the palmaris longus. It is always united to the transverse carpal ligament and passes laterally and medially into the thenar and hypothenar fasciae. Small at the transverse carpal ligament, it broadens toward the fingers and sends off bands which are lost in the skin of the basal portions of the second to the fifth fingers. In addition to the longitudinal fibres there are *transverse fasciculi,* especially distally. These bound proximally the gaps between the bands passing to the fingers, through which gaps pass nerves and vessels for the adjacent sides of the individual fingers and also the tendons of the lumbrical muscles.

The **Palmaris brevis** arises from the ulnar border of the palmar aponeurosis and occasionally from the trapezium (greater multangular). It is usually formed of a number of separate bundles and is inserted into the skin of the hand on its ulnar border. *Nerve:* Superficial volar branch of the ulnar. *Action:* Tenses the skin of the hand on the volar side.

The Hypothenar Muscles.

The **Abductor digiti quinti** arises from the pisiform bone and is inserted into the dorsal aponeurosis of the little finger. The **Flexor digiti quinti brevis** is inconstant. It arises from the transverse carpal ligament and the hamulus of the unciform (hamate) bone and is inserted into the basal phalanx of the fifth finger. The **Opponens digiti quinti** has the same origin as the preceding and inserts into the ulnar border of the fifth metacarpal. *Nerve:* The deep volar branch of the ulnar. *Action:* Indicated by their names.

Fig. 286. The palmar aponeurosis and the palmaris brevis exposed by removing the skin from the volar surface of the hand. ($^3/_4$)
The thenar and hypothenar muscles are covered by fascia. * = continuations of the aponeurosis into the corium of the fingers.

Fig. 287. Tendons and muscles (interossei dorsales) of the back of the hand. ($^3/_4$)
The dorsal carpal ligament has been retained, but the dorsal fascia is removed. 1 = part of the dorsal aponeurosis derived from the extensor digitorum; 2 = lateral part formed by the interosseous and lumbrical tendons; 3 = continuation upon the terminal phalanx.

The Muscles of the Hand. (Cont.)

The Thenar Muscles.

The **Abductor pollicis brevis,** Opponens pollicis and the superficial head of the Flexor pollicis brevis form a superficial sheet of thenar muscles, and the deep head of the Flexor and the Adductor pollicis a deep layer.

The **Abductor pollicis brevis** arises from the transverse carpal ligament and receives a slip from the tendon of the abductor pollicis longus. It inserts into the basal phalanx of the thumb. *Nerve:* Median. *Action:* Abducts the thumb and aids in opposing it.

The **Opponens pollicis** arises from the transverse carpal ligament and the trapezium (greater multangular) and is inserted into the whole of the radial border of the metacarpal of the thumb up to its capitulum. *Nerve:* Median. *Action:* Opposes the thumb and aids in abduction.

The **Flexor brevis pollicis** arises by its *superficial head* from the tuberosity of the trapezium (greater multangular) and from the transverse carpal ligament; by its *deep head* from the trapezium (greater multangular) at the bottom of the carpal canal. It is inserted into the radial sesamoid bone at the metacarpo-phalangeal joint of the thumb. *Nerve:* The median for the superficial head, the deep volar branch of the ulnar for the deep head. *Action:* Flexes the basal phalanx of the thumb.

The **Abductor pollicis** has two heads. The *oblique head* arises from the os magnum (capitate) and unciform (hamate) at the bottom of the carpal canal; the *transverse head* arises from the volar surface of the third metacarpal. The insertion is into the ulnar sesamoid bone of the metacarpo-phalangeal joint of the thumb. *Nerve:* Deep volar branch of the ulnar. *Action:* Adducts the thumb and helps to oppose it.

Fig. 288. The palmar muscles after removal of the palmar aponeurosis. ($^3/_4$)
The tendon sheath of the middle finger is split open.

Fig. 289. The deep layer of the palmar muscles and the pronator quadratus. ($^3/_4$)
The transverse carpal ligament is cut across and also the abductor digiti V and abductor pollicis brevis. The tendons of the flexor sublimis have been taken out of the carpal canal and after splitting the tendon sheaths on the fingers, have been partly removed.

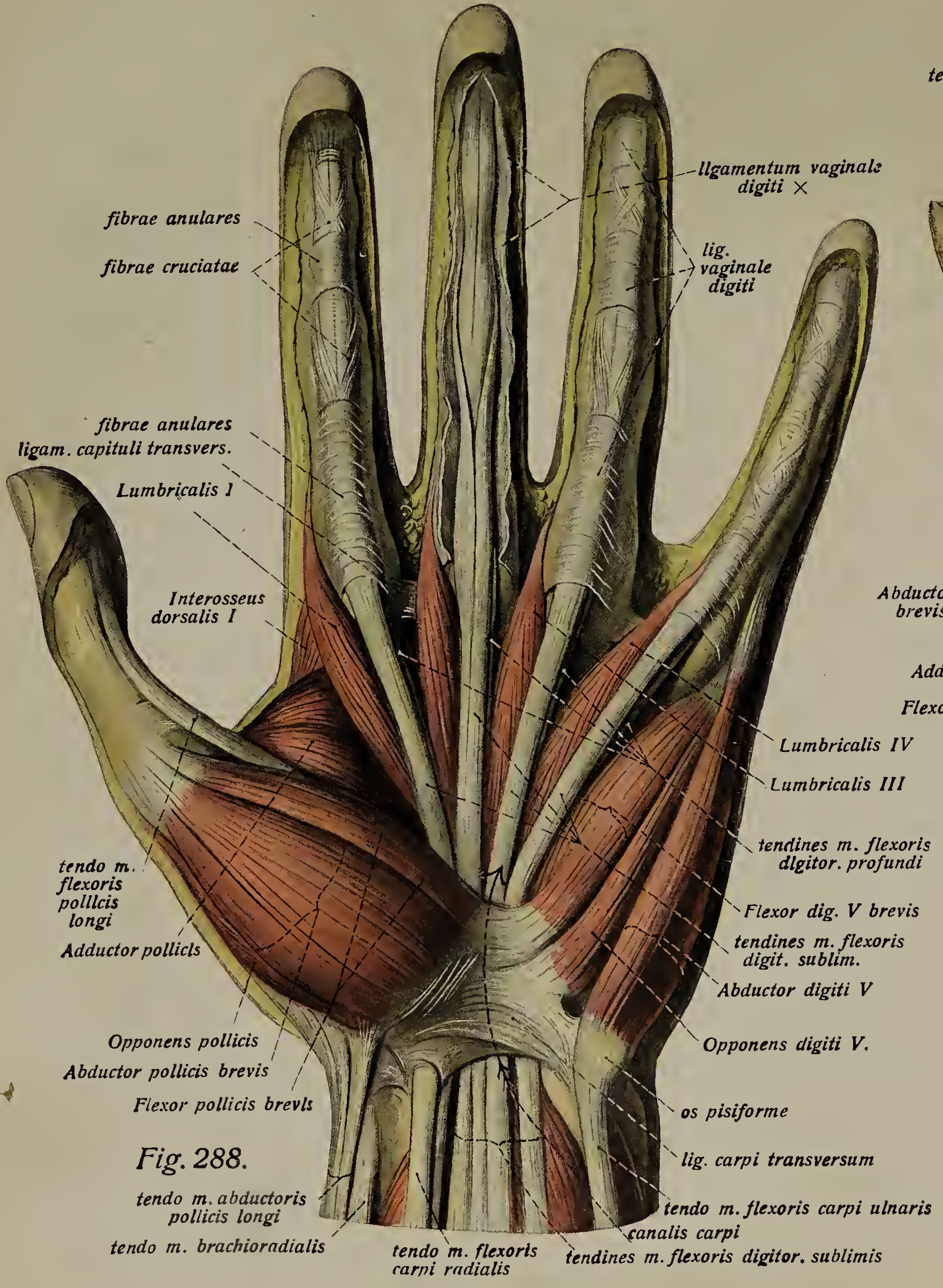


Fig. 288.

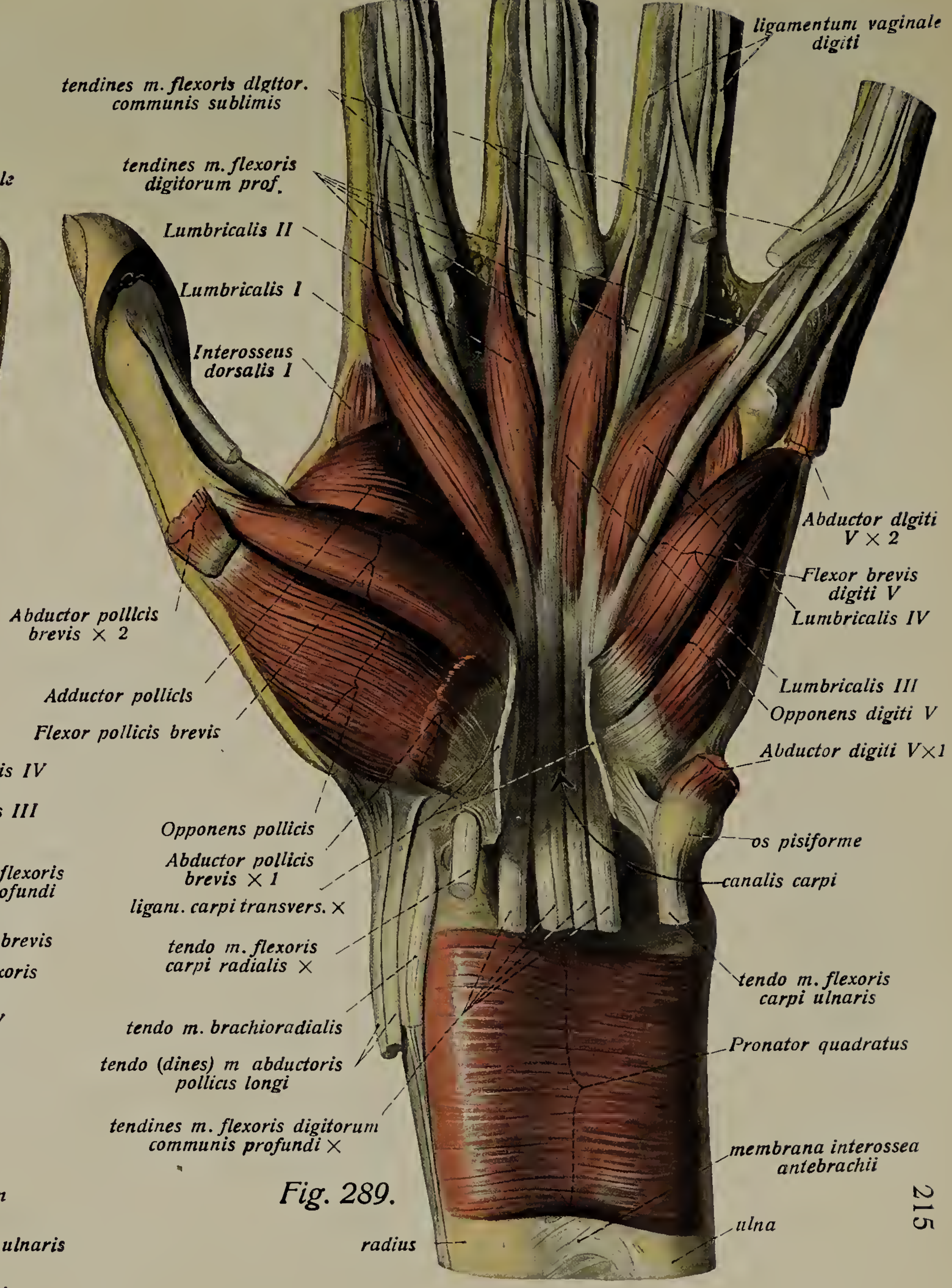

ligamentum vaginale digiti
tendines m. flexoris digitor. communis sublimis
tendines m. flexoris digitorum prof.
Lumbricalis II
Lumbricalis I
Interosseus dorsalis I
Abductor digiti V × 2
Flexor brevis digiti V
Abductor pollicis brevis × 2
Lumbricalis IV
Lumbricalis III
Adductor pollicis
Opponens digiti V
Flexor pollicis brevis
Abductor digiti V×1
Opponens pollicis
os pisiforme
Abductor pollicis brevis × 1
canalis carpi
ligam. carpi transvers. ×
tendo m. flexoris carpi radialis ×
tendo m. flexoris carpi ulnaris
tendo m. brachioradialis
Pronator quadratus
tendo (dines) m abductoris pollicis longi
tendines m. flexoris digitorum communis profundi ×
membrana interossea antebrachii
radius
ulna

Fig. 289.

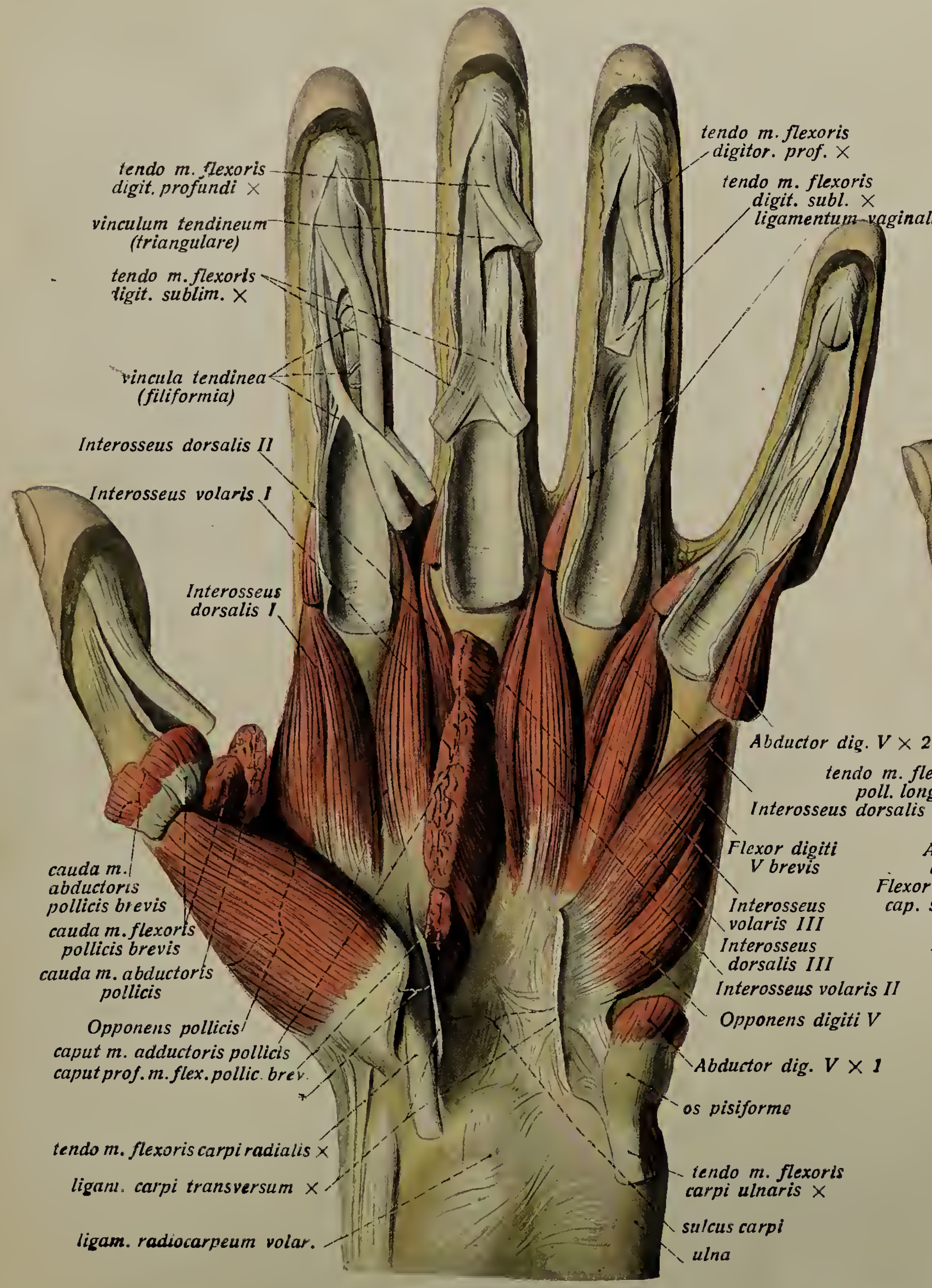

tendo m. flexoris digit. profundi ×
vinculum tendineum (triangulare)
tendo m. flexoris digit. sublim. ×
vincula tendinea (filiformia)
Interosseus dorsalis II
Interosseus volaris I
Interosseus dorsalis I
cauda m. abductoris pollicis brevis
cauda m. flexoris pollicis brevis
cauda m. abductoris pollicis
Opponens pollicis
caput m. adductoris pollicis
caput prof. m. flex. pollic. brev.
tendo m. flexoris carpi radialis ×
ligam. carpi transversum ×
ligam. radiocarpeum volar.
tendo m. flexoris digitor. prof. ×
tendo m. flexoris digit. subl. ×
ligamentum vaginale ×
Abductor dig. V × 2
tendo m. flexoris poll. long. ×
Interosseus dorsalis IV
Flexor digiti V brevis
Interosseus volaris III
Interosseus dorsalis III
Interosseus volaris II
Opponens digiti V
Abductor dig. V × 1
os pisiforme
tendo m. flexoris carpi ulnaris ×
sulcus carpi
ulna

Fig. 291.

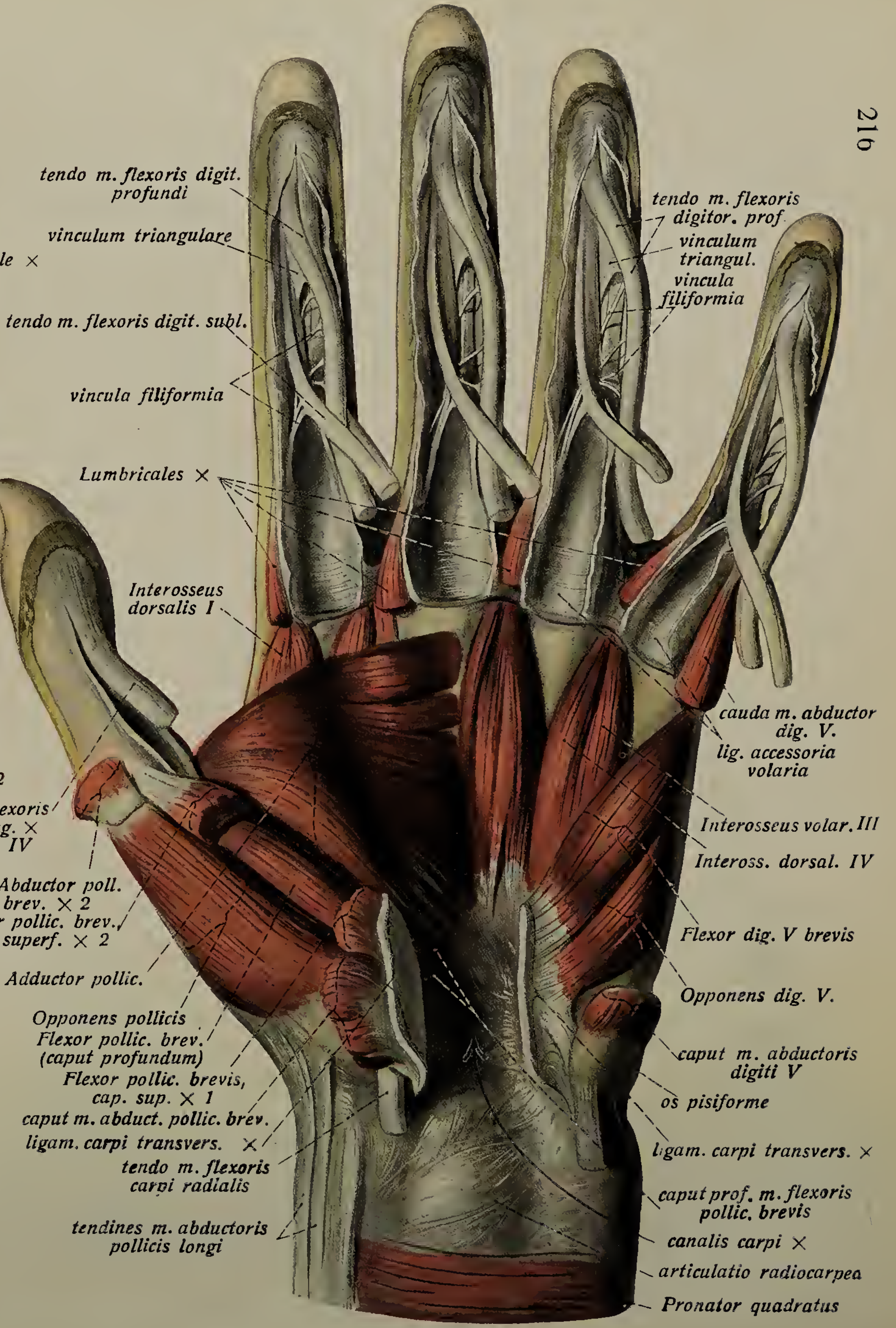

tendo m. flexoris digit. profundi
vinculum triangulare
tendo m. flexoris digit. subl.
vincula filiformia
Lumbricales ×
Interosseus dorsalis I
Abductor poll. brev. × 2
Flexor pollic. brev. cap. superf. × 2
Adductor pollic.
Opponens pollicis
Flexor pollic. brev. (caput profundum)
Flexor pollic. brevis, cap. sup. × 1
caput m. abduct. pollic. brev.
ligam. carpi transvers. ×
tendo m. flexoris carpi radialis
tendines m. abductoris pollicis longi
tendo m. flexoris digitor. prof
vinculum triangul.
vincula filiformia
cauda m. abductor dig. V.
lig. accessoria volaria
Interosseus volar. III
Inteross. dorsal. IV
Flexor dig. V brevis
Opponens dig. V.
caput m. abductoris digiti V
os pisiforme
ligam. carpi transvers. ×
caput prof. m. flexoris pollic. brevis
canalis carpi ×
articulatio radiocarpea
Pronator quadratus

Fig. 290

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Hand. (Cont.)

The Interossei.

The interossei lie in the intervals between the metacarpal bones. They insert by expanded tendons into the dorsal aponeurosis of the fingers on the basal phalanges. The dorsal interossei arise each by two heads from the borders of adjacent metacarpal bones.

The **First dorsal interosseus** arises from the first and second metacarpal, the **Second** from the second and third, the **Third** from the third and fourth and the **Fourth** from the fourth and fifth. The first and second insert into the radial side of the dorsal aponeurosis of the second and third fingers and the third and fourth into the ulnar side of the aponeurosis of the third and fourth fingers. *Nerve:* Deep volar branch of the ulnar. *Action:* Abduction of the fingers. Extension of the two distal phalanges and flexion of the basal ones.

The **Interossei volares** arise each by a single head, the **first** from the ulnar border of the second metacarpal, the **second** from the radial border of the fourth and the **third** from the radial border of the fifth. The first inserts into the ulnar side of the dorsal aponeurosis of the second finger, the second and third into the radial sides of the fourth and fifth fingers. *Nerve:* Deep volar branch of the ulnar. *Action:* Adduction of the fingers. Extension and flexion as with the dorsal interossei.

Fig. 290. The deep palmar muscles. ($^3/_4$)
The carpal canal is opened and the flexor tendons removed, except that of the flexor carpi radialis. The vaginal ligaments of the digital tendon sheaths are split open and the abductor pollicis brevis, the superficial head of the flexor pollicis brevis and the abductor digiti V have been removed.

Fig. 291. The deep layer of the palmar muscles. ($^3/_4$)
The preparation is much as in Fig. 290 but the adductor pollicis and the deep head of the flexor pollicis brevis have also been removed; the tendons of the fingers have been cut near their insertions. * = tendon sheath for the flexor carpi radialis, opened.

The Muscles of the Upper Extremity. (Cont.)

The Muscles of the Hand. (Cont.)

Fig. 294. The tendons of the index finger, half schematic. (1/1)
The volar tendon sheath has been removed.

Fig. 295. The tendon sheaths of the hand, half schematic. (3/4)
The sheath of the flexor carpi ulnaris is partly exposed by cutting away a part of the thenar musculature. On the ring and little fingers the vaginal ligaments are split lengthwise.

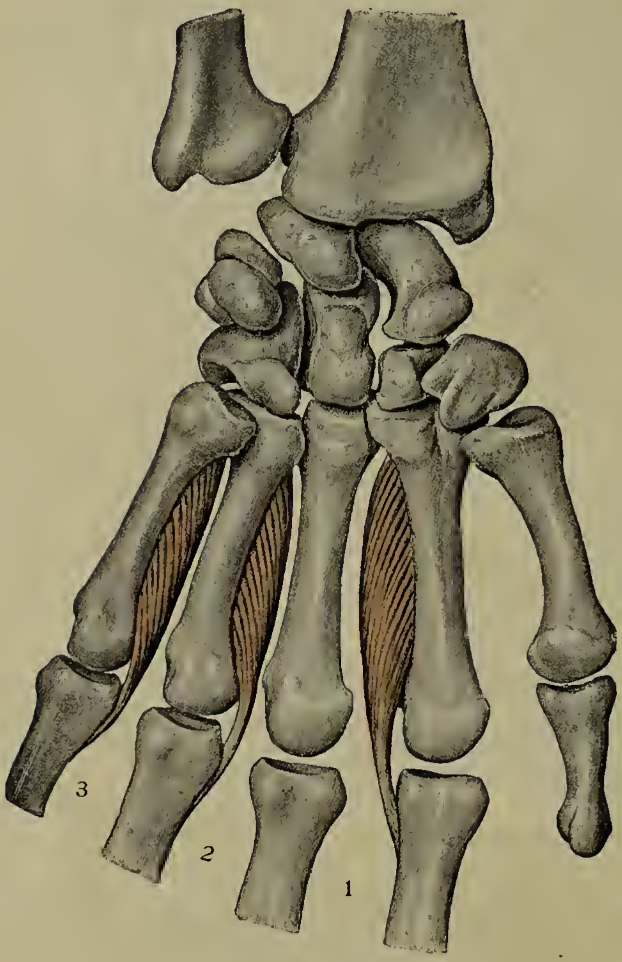


Fig. 292.
Schema of the volar interossei.

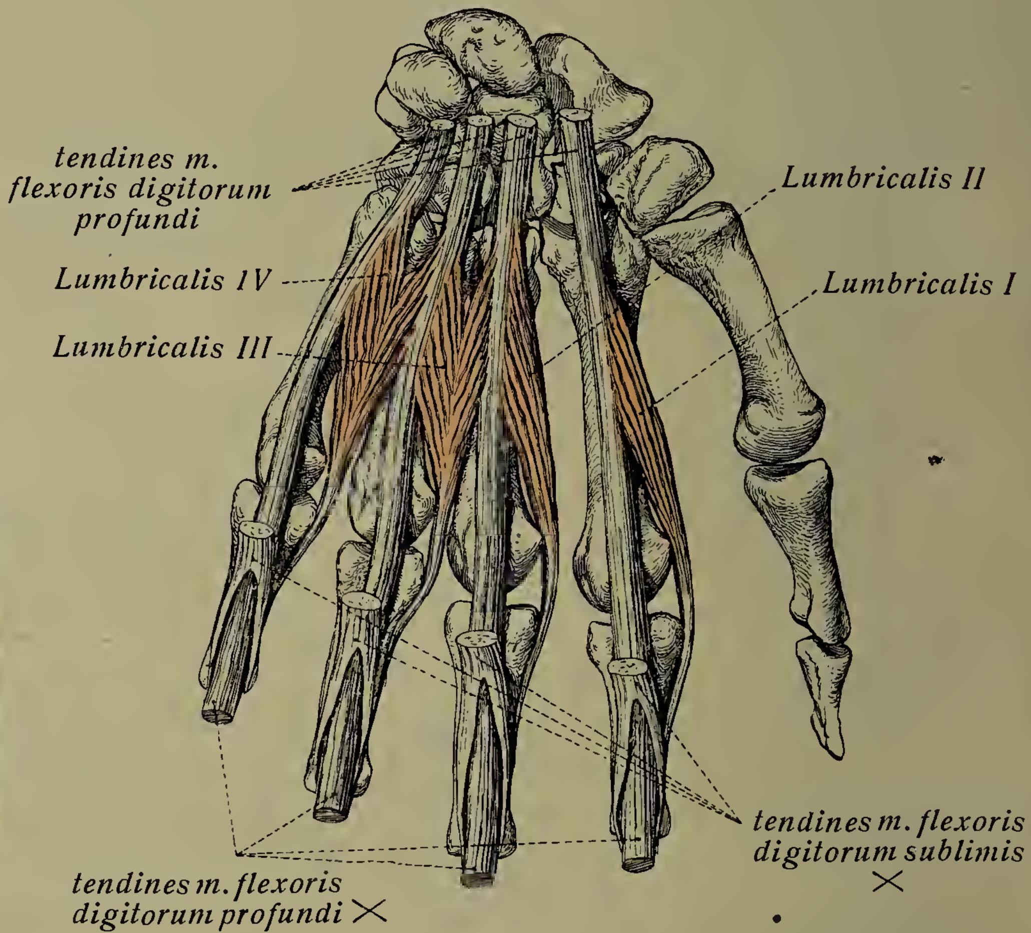

tendines m. flexoris digitorum profundi
Lumbricalis IV
Lumbricalis III
Lumbricalis II
Lumbricalis I
tendines m. flexoris digitorum sublimis ×
tendines m. flexoris digitorum profundi ×

Fig. 293.
Schema of the lumbrical muscles.

The **Lumbrical muscles** arise from the tendons of the flexor digitorum profundus, the two radial usually each by a single head and the two ulnar each by two heads from the sides of adjacent tendons. They insert into the radial side of the dorsal aponeuroses of the second to the fifth fingers. *Nerve:* The one or two radial by the median, the two or three ulnar by the ulnar. *Action:* Flex the basal phalanges and extend the terminal ones.

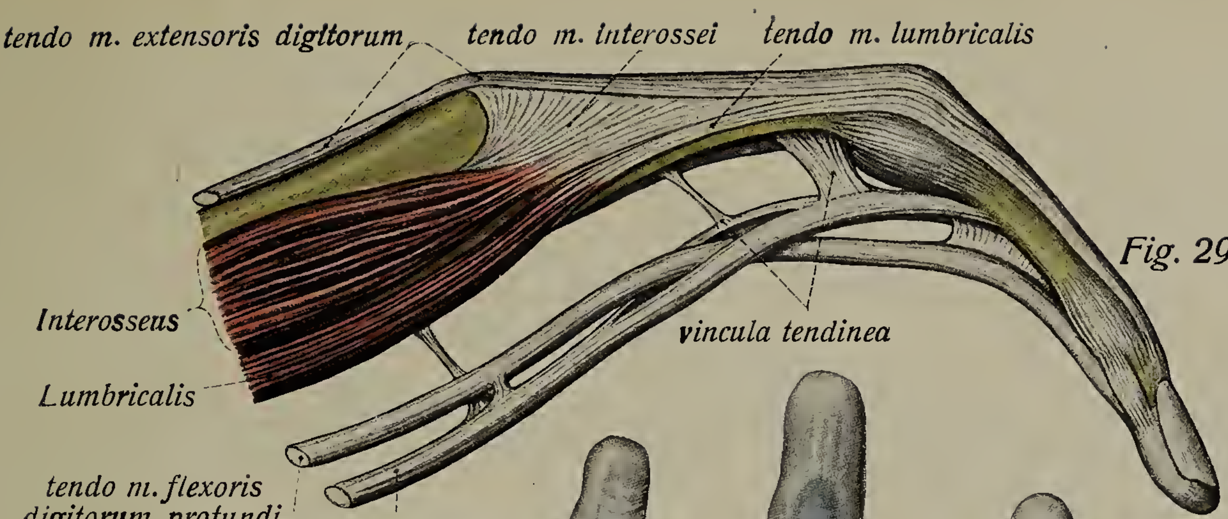

tendo m. extensoris digitorum
tendo m. interossei
tendo m. lumbricalis
Interosseus
Lumbricalis
vincula tendinea
tendo m. flexoris digitorum profundi
tendo m. flexoris digitorum sublimis

Fig. 294.

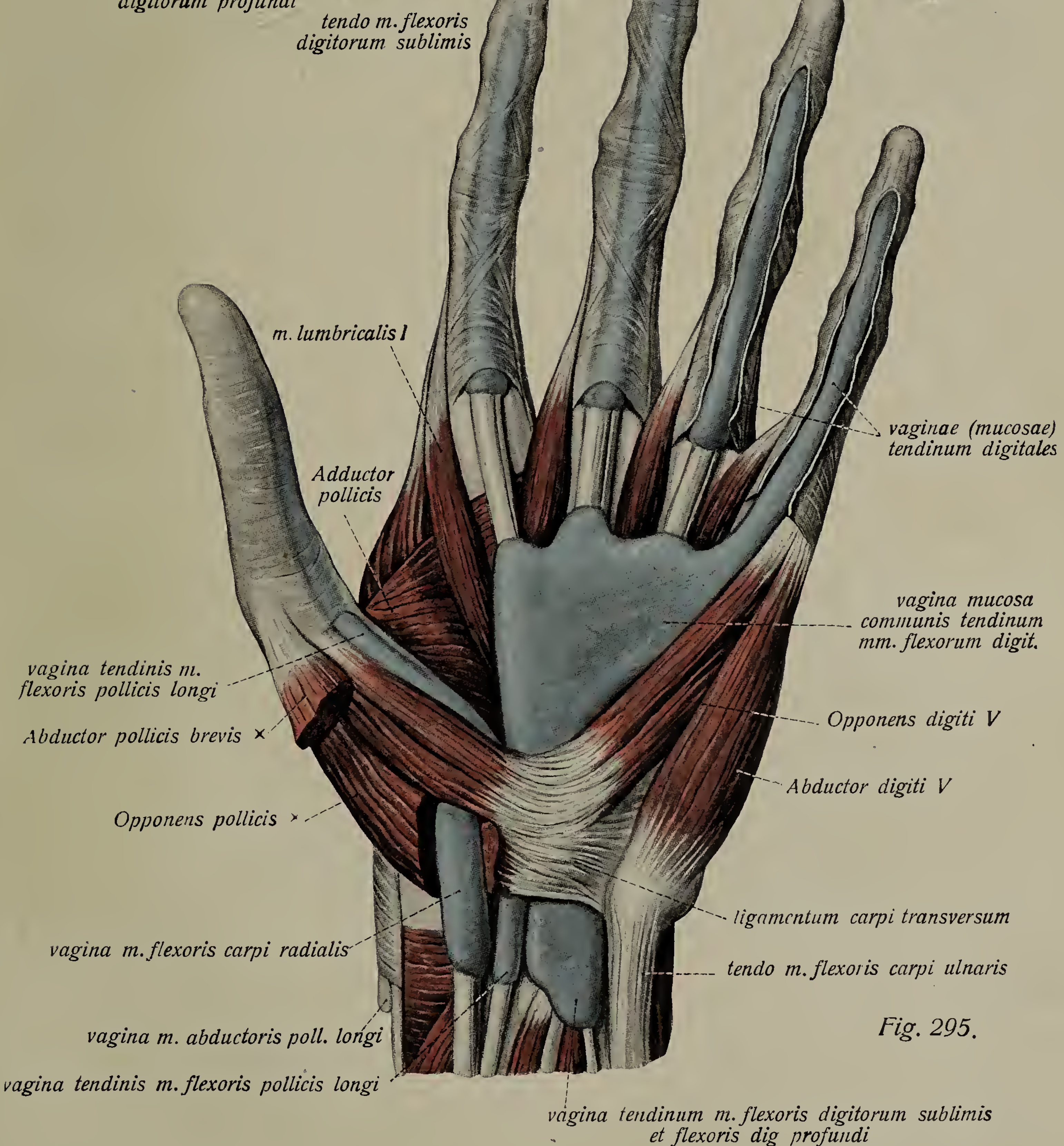

m. lumbricalis I
Adductor pollicis
vaginae (mucosae) tendinum digitales
vagina mucosa communis tendinum mm. flexorum digit.
vagina tendinis m. flexoris pollicis longi
Abductor pollicis brevis ×
Opponens digiti V
Abductor digiti V
Opponens pollicis ×
ligamentum carpi transversum
vagina m. flexoris carpi radialis
tendo m. flexoris carpi ulnaris
vagina m. abductoris poll. longi
vagina tendinis m. flexoris pollicis longi
vagina tendinum m. flexoris digitorum sublimis et flexoris dig profundi

Fig. 295.

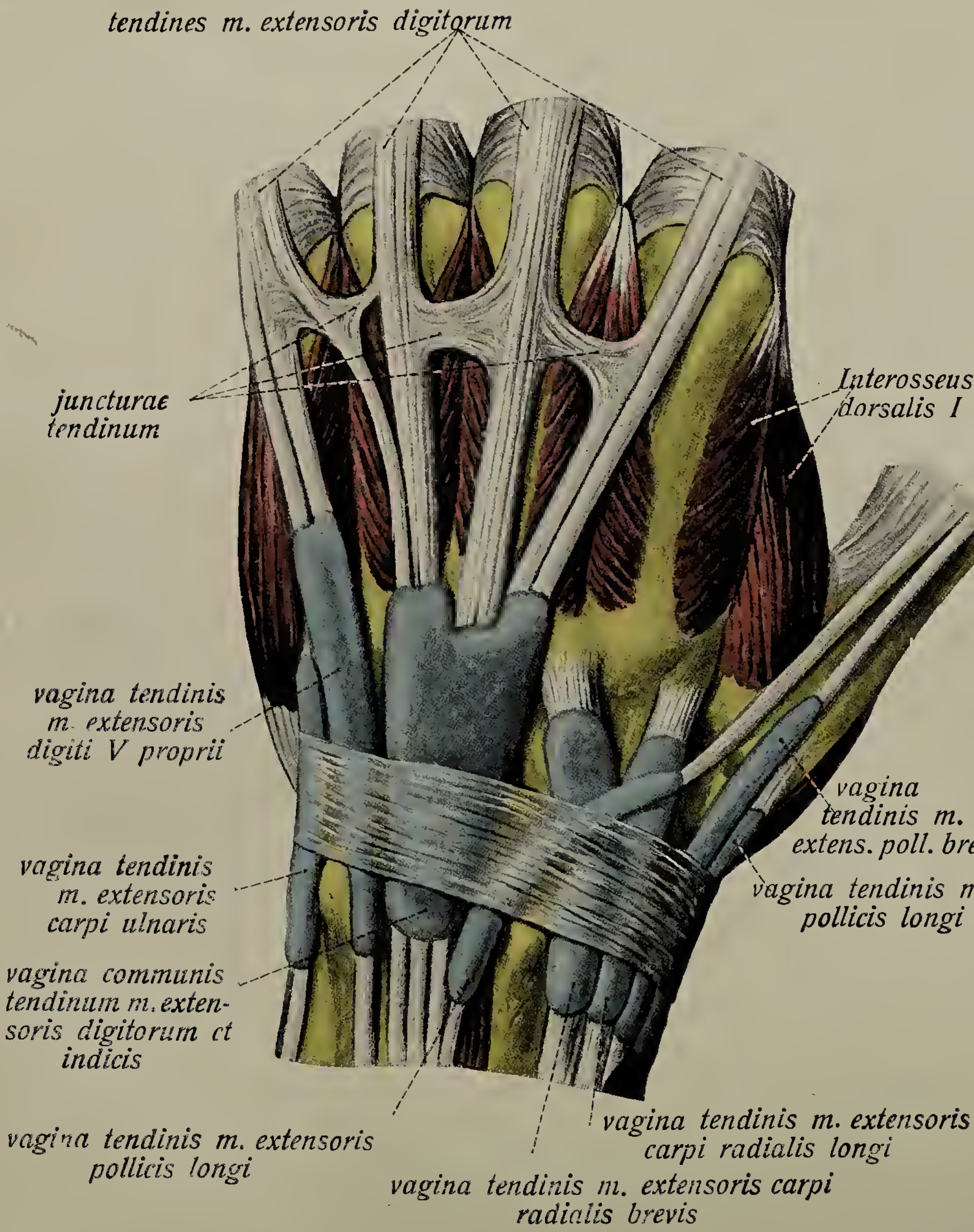

tendines m. extensoris digitorum
juncturae tendinum
Interosseus dorsalis I
vagina tendinis m. extensoris digiti V proprii
vagina tendinis m. extens. poll. brevis
vagina tendinis m. abductoris pollicis longi
vagina tendinis m. extensoris carpi ulnaris
vagina communis tendinum m. extensoris digitorum et indicis
vagina tendinis m. extensoris pollicis longi
vagina tendinis m. extensoris carpi radialis longi
vagina tendinis m. extensoris carpi radialis brevis

Fig. 296.

Tendon sheats of the dorsum of the hand.
(semischematic)

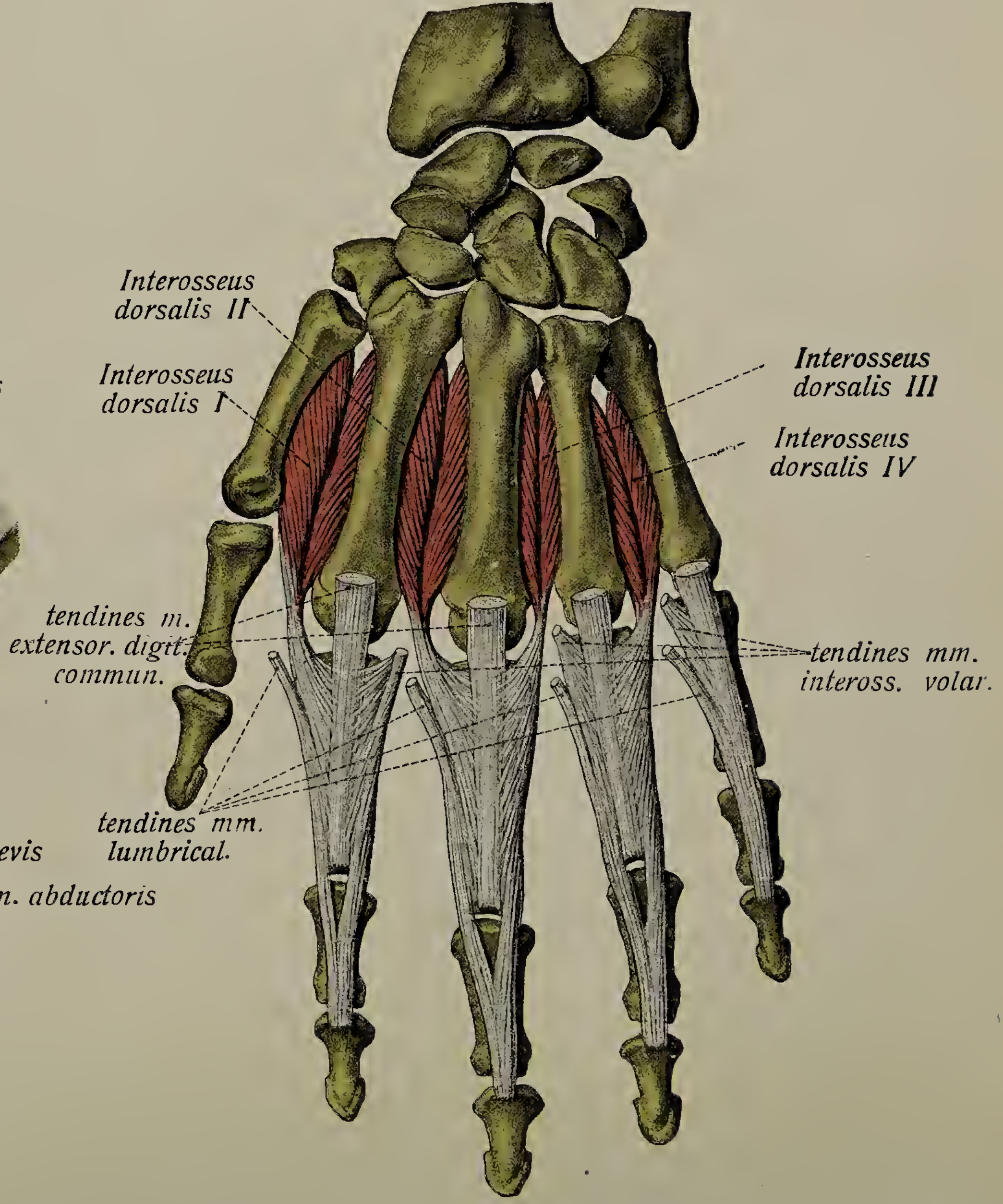


Fig. 297.

Schema of the Dorsal interossei of the hand.

Tab. 2.

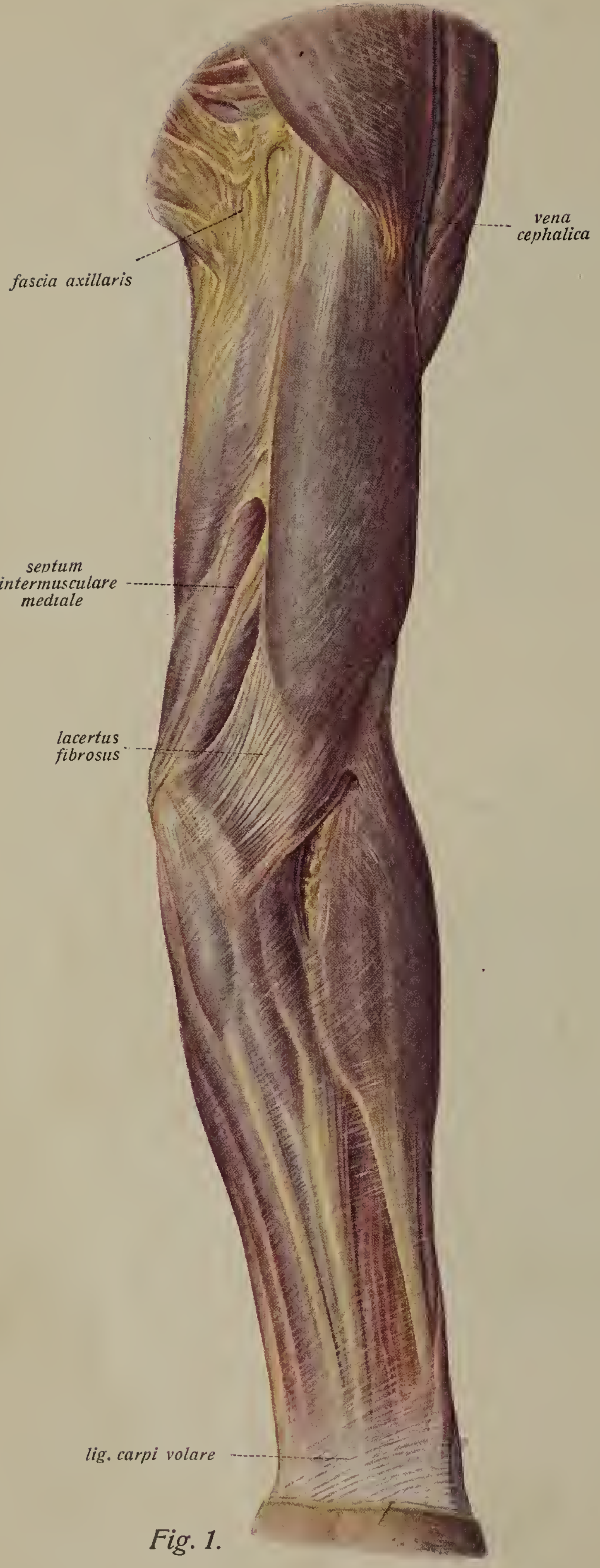


Fig. 1.

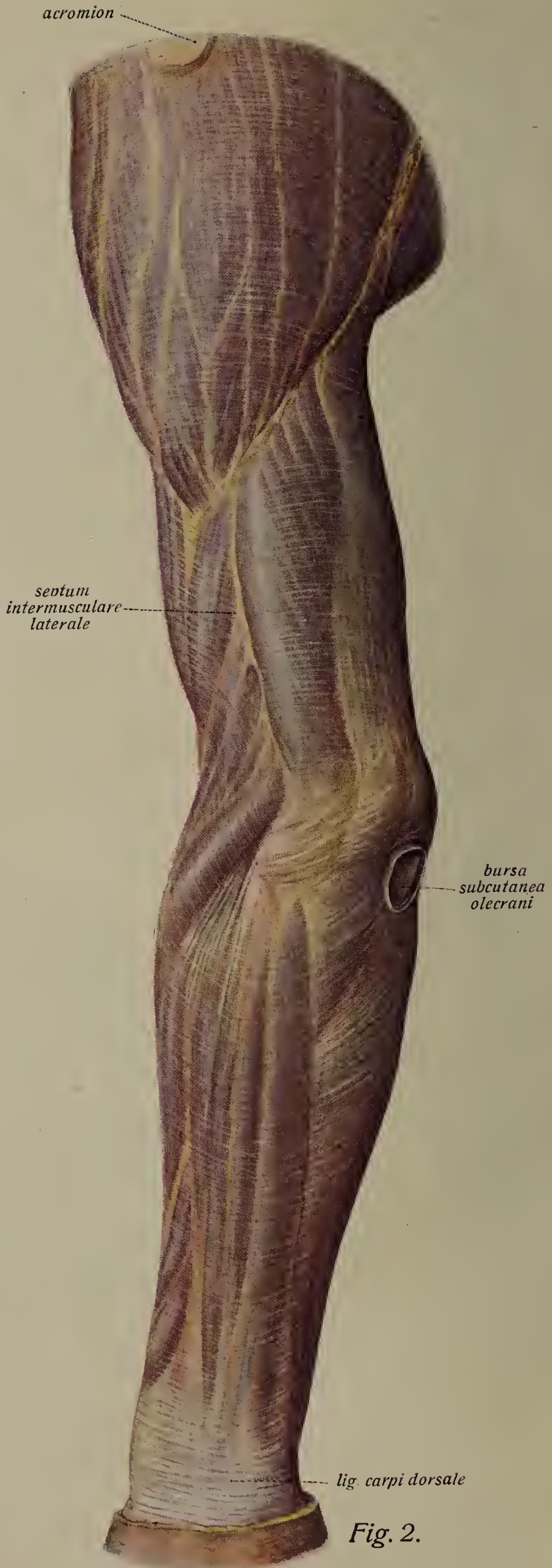


Fig. 2.

The Fasciae of the Upper Extremity.

Plate 2.

Fig. 1. Fascia of the left upper extremity from the volar surface. ($^3/_7$)
Fig. 2. Fascia of the left upper extremity from the dorsal surface. ($^3/_7$)

The muscles of the upper extremity are enclosed in a common fascia, which receives different names in different regions. At the shoulder there is an axillary fascia, a supraspinatus, an infraspinatus and a subscapular; on the upper arm the brachial fascia; on the forearm the antebrachial fascia and in the hand the dorsal fascia and the palmar aponeurosis.

The *axillary fascia* is a thin membrane which forms the base of the axillary cavity. It is pierced by many blood vessels and possesses a few stronger deeper bundles extending from the latissimus to the pectoralis, these being sometimes muscular and then termed the *axillary arch.* The *suspraspinatus fascia* covers the muscle of that name and is partly tendinous in character. The *infraspinatus fascia* is a very thick, tendinous fascia covering the infraspinatus and teres minor and partly also the teres major, giving origin to some of the fibres of the two former. The *subscapular fascia* covers the muscle of that name.

The *brachial fascia* is continuous above with the fasciae just mentioned and reaches its greatest thickness at the insertion of the deltoid. It consists largely of transverse fibres and anteriorly is moulded over the biceps, on either side of which is a groove, a *medial* and less noticeable *lateral bicipital groove.* In the lower part of the upper arm it gives off septa, separating the two muscle groups of that region, a strong and broad *medial intermuscular septum* extending to the medial epicondyle and a frequently thin *lateral intermuscular septum* ending at the lateral epicondyle.

The *antebrachial fascia* is continuous with the brachial at the elbow joint and, immediately below this, it gives origin to fibres of the superficial layers of the extensor and flexor muscles. The *lacertus fibrosus* of the biceps is also essentially a portion of the fascia. The fascia is thinnest in the cubital fossa and over the brachio-radialis and extensor carpi radialis longus, which do not take origin from it. Toward the wrist it is thickened volarly and dorsally by circular fibres to form the *volar carpal ligament*, holding down the long flexor tendons, and the *dorsal carpal ligament*, a broad, oblique and very strong band, which unites with the dorsal surfaces of the bones of the forearm and forms the six canals for the eight tendon sheaths of the eleven extensor tendons (see Fig. 296.

The *dorsal fascia of the hand* is very thin, while the palmar aponeurosis, described above, is very strong, by far the strongest portion of the fascia of the arm.

The Muscles of the Lower Extremity.

The muscles of the lower extremity may be classified as those of the rump, those of the thigh, those of the lower leg and those of the foot. The rump muscles pass from the innominate bone to the upper part of the thigh.

The muscles of the thigh are arranged in three groups; an anterior extensor group, a posterior flexor and a medial adductor. In the lower leg three groups may again be distinguished: an anterior extensor group, a lateral peroneal group and a posterior flexor group. This last consists of two layers, a superficial and a deep. In the foot are the dorsal extensor and the plantar flexor muscles. The latter may be grouped into the medial muscles, those of the great toe, those of the little toe, the lumbricals and the interossei.

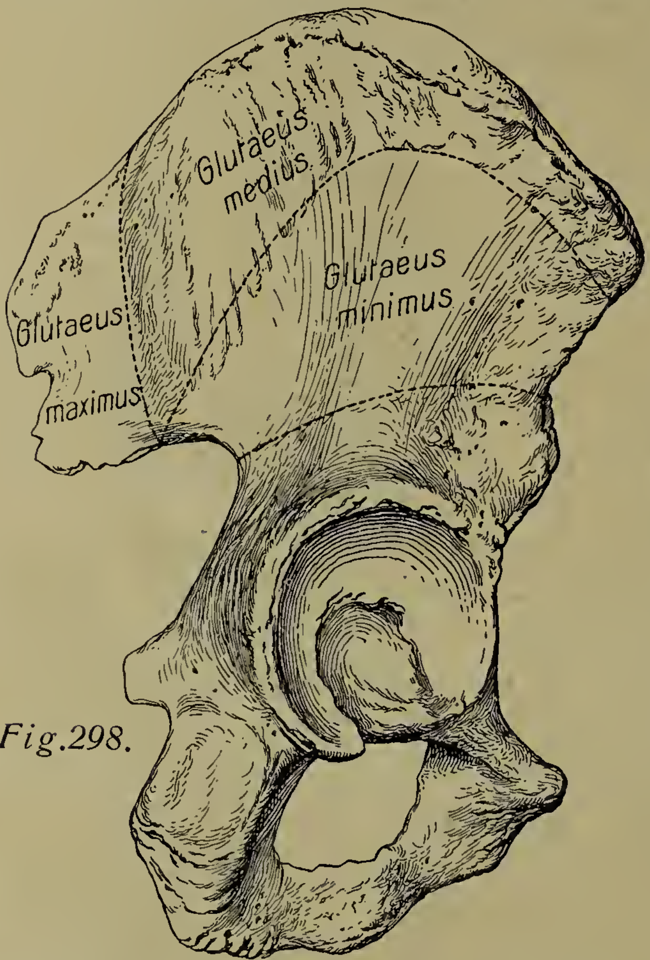


Fig.298.

Fig. 298. The origins of the three gluteal muscles from the ala of the ilium. The gluteal lines are dotted.

The Muscles of the Rump.

The **Glutaeus maximus** arises from the posterior part of the ala of the ilium behind the posterior gluteal line, from the dorsal surface of the sacrum and from the sacrotuberous ligament. It is inserted into the gluteal tuberosity of the femur, also sending a slip to the iliotibial band of the fascia lata. *Nerve:* The inferior gluteal. *Action:* Extension of the thigh; aids also in adduction and outward rotation.

The **Glutaeus medius** arises from the lateral surface of the ala of the ilium, above the anterior gluteal line, and is inserted into the lateral surface of the great trochanter. *Nerve:* The superior gluteal. *Action:* Abduction of the thigh, assists also by its posterior portion in outward rotation and by its anterior portion in inward rotation.

The **Glutaeus minimus** arises from the lateral surface of the ala of the ilium, between the anterior and inferior gluteal lines. It inserts into the tip of the great trochanter. *Nerve:* The superior gluteal. *Action:* Abduction of the thigh and external rotation.

The **Piriformis** arises from the lateral part of the pelvic surface of the sacrum, in the region of the second to the fourth sacral foramina. It passes outward through the great sciatic foramen and is inserted into the tip of the great trochanter. *Nerve:* Branch from the sciatic or the sciatic plexus. *Action:* External rotation of the thigh, assists also in abduction.

Fig. 299. The superficial layer of the posterior rump muscles. ($^1/_4$)
* = position of the great trochanter.

Fig. 300. The middle layer of the posterior rump muscles. ($^1/_4$)
The glutaeus maximus is cut away.

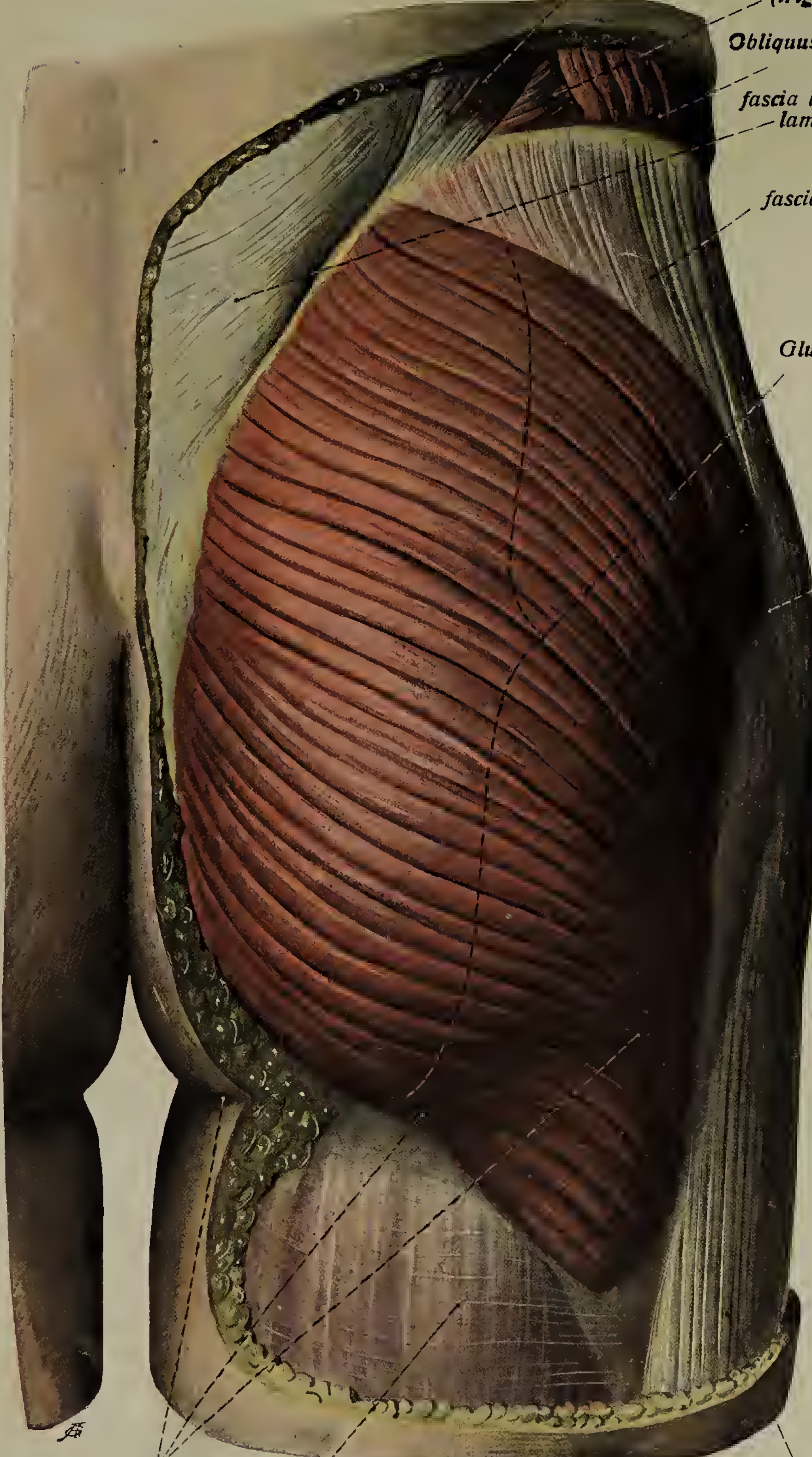

Latissimus dorsi
Obliquus abdominis internus (trigonum lumbale)
Obliquus abd. externus
fascia lumbodorsalis, lamina poster.
fascia glutaealis
Glutaeus maximus
*
sulcus glutaeus
fascia lata
fascia lata (tractus iliotibialis)

Fig. 299.

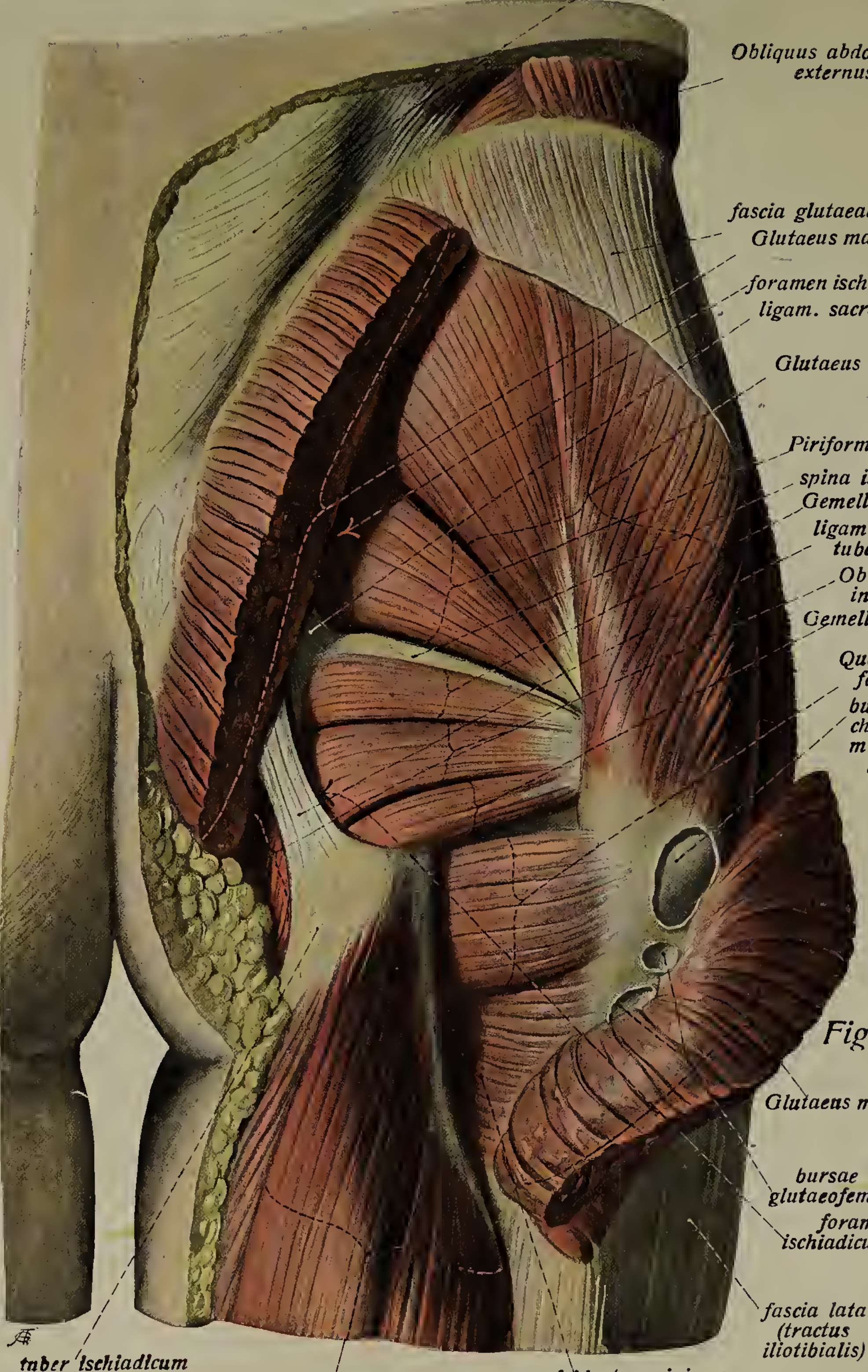


Fig. 300.

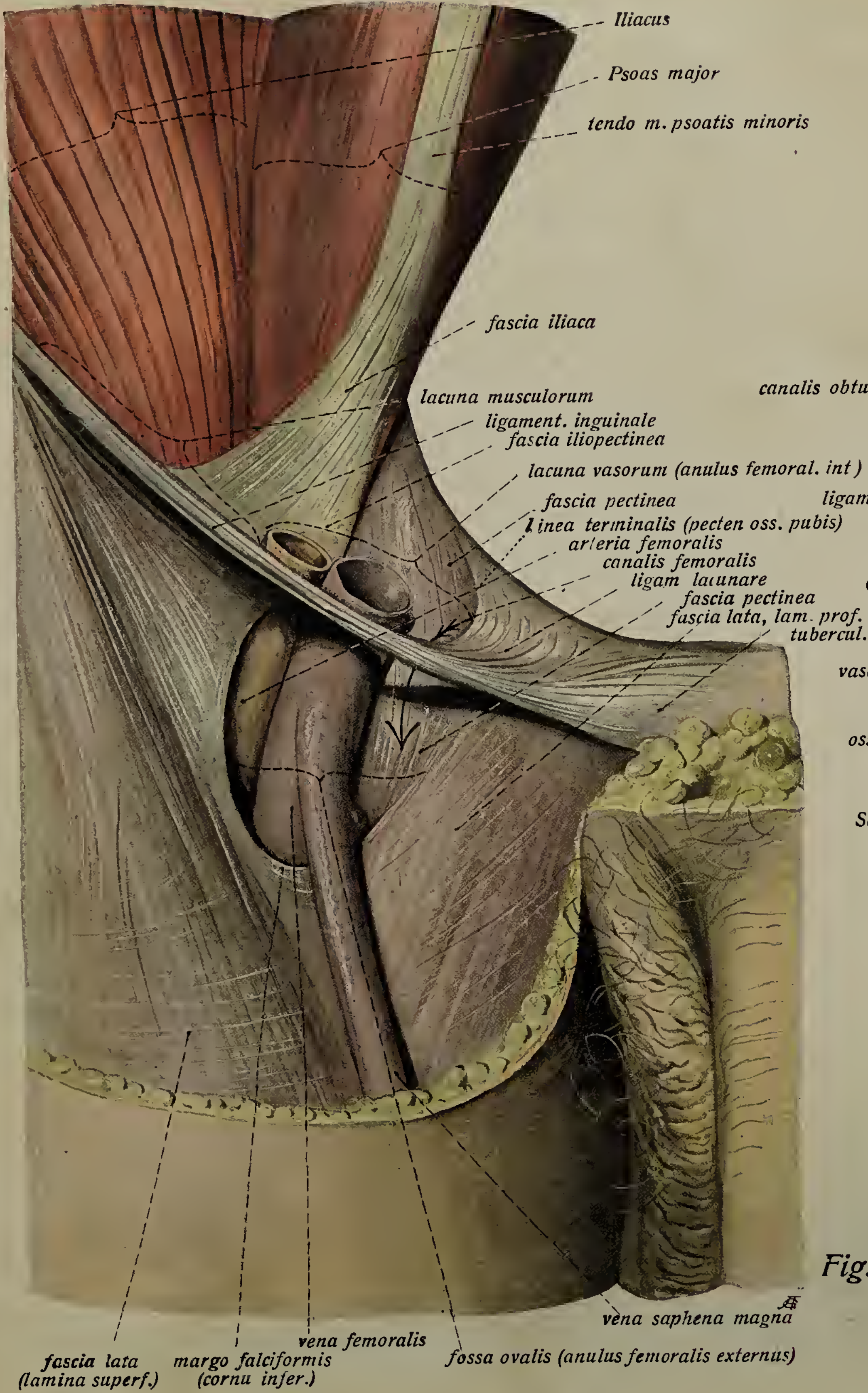


Fig. 301.

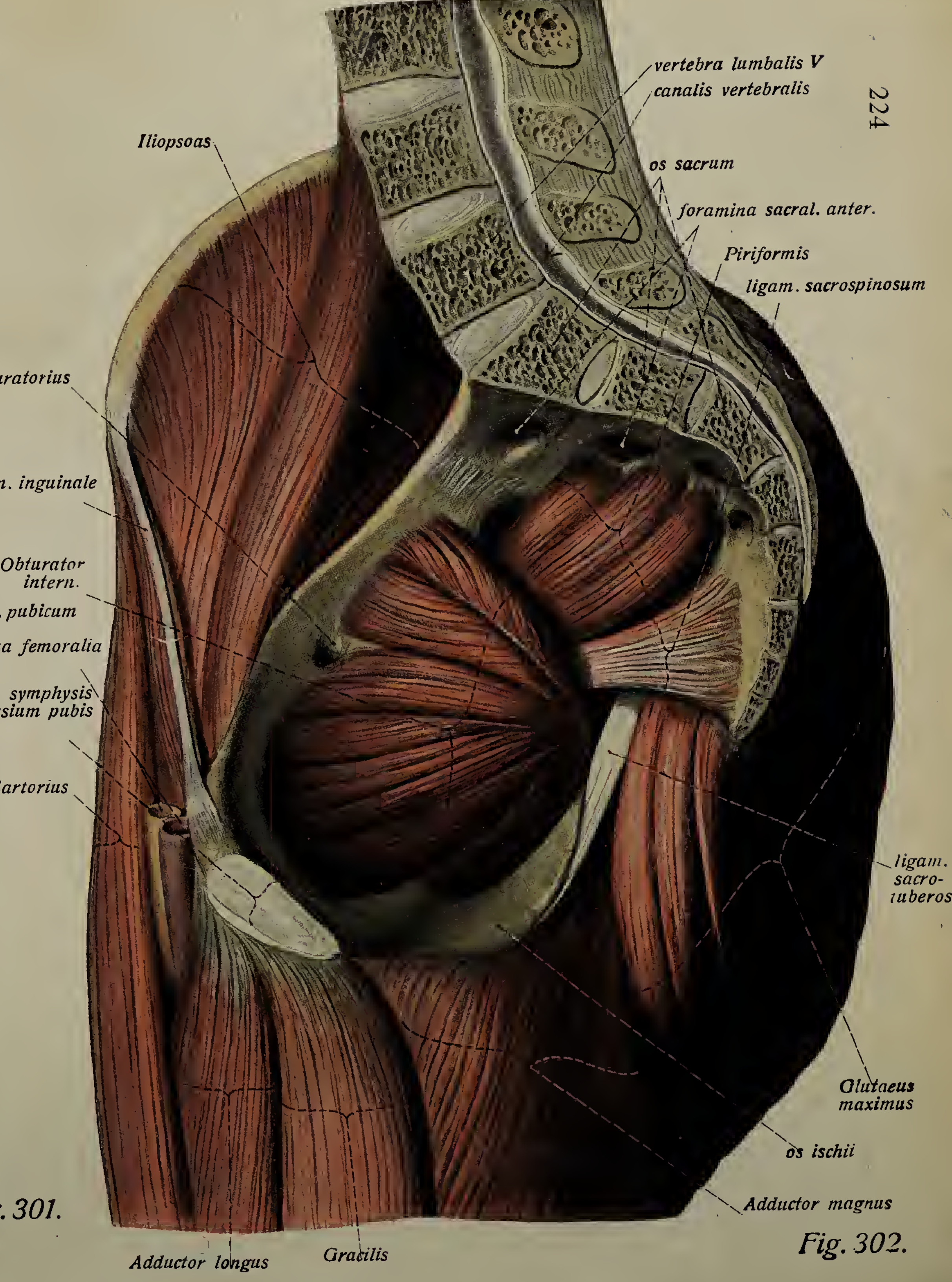


Fig. 302.

The Muscles of the Inferior Extremity. (Cont.)

The Muscles of the Rump. (Cont.)

The **Obturator internus** arises from the pelvic surface of the circumference of the obturator foramen and from the obturator membrane. It passes out through the lesser sciatic foramen, bends around the base of the ischial tuberosity and inserts into the trochanteric fossa of the femur. The **Gemellus superior** takes origin from the spine of the ischium and the **Gemellus inferior** from the ischial tuberosity; they join the tendon of the obturator internus. *Nerve:* Branches from the sacral plexus. *Action:* External rotators and adductors.

The **Quadratus femoris** arises from the lateral border of the ischial tuberosity and passes outwards to the intertrochanteric crest. *Nerve:* A special branch from the sciatic plexus. *Action:* External rotation and adduction.

The **Tensor fasciae latae** arises from the anterior superior spine of the ilium and is inserted into the ilio-tibial band of the fascia lata. *Nerve:* The superior gluteal. *Action:* Tenses the fascia lata and assists in flexion and inward rotation of the thigh.

The Fascia of the Lower Extremity.

The muscles of the lower limb are enclosed in a fascia, which, in places, is exceptionally strong. That part that covers the ilio-psoas is termed the iliac fascia, that which invests the thigh muscles, the fascia lata, that of the lower leg, the crural, and in the foot there is a dorsal fascia and the strongly tendinous plantar aponeurosis. (see p. 241.)

The *iliac fascia* invests the ilio-psoas muscle and, at its medial border, passes over into the pelvic fascia. Below it passes upon the muscles of the thigh and unites with the pectineal fascia to form the *ilio-pectineal fascia.* This divides the space below the inguinal ligament into two compartments or lacunae, a lateral *lacuna musculorum* for the ilio-psoas and the femoral nerve and a medial *lacuna vasorum* for the femoral vessels.

The *fascia lata* consists of two layers, separable only in certain areas and varying much in thickness. It is stronger on the posterior and lateral surfaces of the thigh than on the anterior and medial. Its superficial layer, just below the inguinal ligaments, forms a free medial border, the *falciform border,* which, with the deep layer, the *pectineal fascia,* forms the boundary of the *fossa ovalis.* The lower border of the fossa is termed the *inferior cornu* and the upper the *superior cornu.* The fossa is closed by a somewhat sieve-like portion of fascia, the *fascia cribrosa,* a larger opening in this transmitting the great saphenous vein. The fossa represents the external or subcutaneous ring, that is to say, the lower opening of the *femoral canal.* (see p. 233.)

Fig. 301. The fossa ovalis of the fascia lata and the crural canal. ($^9/_{10}$)
The abdominal walls and contents and the iliac fascia have been removed as far down as the inguinal ligament. Below this the integument and lymph nodes over the fossa ovalis have been dissected away.

Fig. 302. The muscles of the true pelvis and the medial side of the thigh. ($^1/_2$)
The pelvis and vertebral column have been divided in the middle line; the viscera, fasciae and peritoneum have been removed.

The Muscles of the Lower Extremity. (Cont.)

Fig. 303. The superficial layer of the muscles of the anterior surface of the thigh. ($^1/_3$)
Fig. 304. The muscles of the anterior surface of the thigh after removal of the sartorius and the inguinal ligament. ($^1/_3$)
* = tendinous wall of the adductor canal.

The Muscles of the Thigh.

The Muscles of the Anterior Surface.

The **Sartorius** arises from the anterior superior spine of the ilium and, crossing the thigh obliquely, inserts into the medial border of the tuberosity of the tibia. It forms with the adductor longus the *femoral trigone* (Scarpa's triangle), and covers the adductor canal. At its insertion it forms with the tendons of the gracilis and semitendinosus the *pes anserinus*, beneath which are one or two bursae. *Nerve:* The femoral. *Action:* Assists in flexion of the thigh, flexes the lower leg and rotates it upwards when flexed.

The **Rectus femoris** arises from the anterior inferior spine of the ilium and the upper margin of the acetabulum. Associated with it and uniting with it in a common tendon are three other muscles. The **Vastus medialis** arises from the medial lip of the linea aspera and is stronger below than above; the **Vastus lateralis** arises from the lateral lip of the linea aspera and from the base of the great trochanter, being stronger above than below; and the **Vastus intermedius** arises from the anterior surface of the femur between the other two, with which it fuses, especially with the medialis. These four muscles constitute what is termed the **Quadriceps femoris** and unite to form a common tendon, that is inserted into the upper and lateral borders of the patella and, by means of the patellar ligament, into the tuberosity of the tibia. Some of the deep fibres of the intermedius insert into the capsule of the knee joint, forming what is termed the **Articularis genu.** *Nerve:* The femoral. *Action:* Draws the patella upwards, extends the lower leg and flexes the thigh.

Behind the tendon of the quadriceps is the *supra-patella bursa,* which communicates with the knee joint, so that the tendon forms part of anterior wall of the capsule of that joint. Extensions from the tendon to the fascia of the lower leg form the *patellar retinacula.* Behind the patellar ligament is a *deep infrapatellar bursa.*

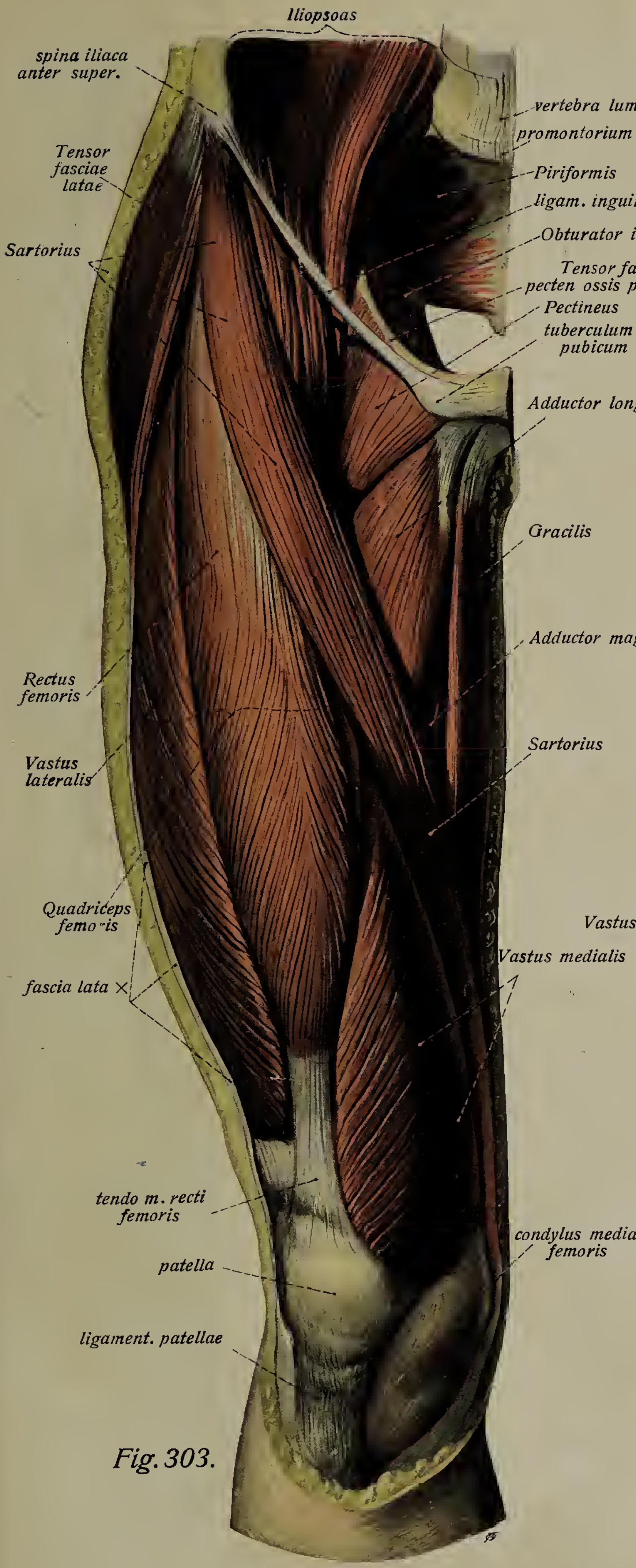


Fig. 303.

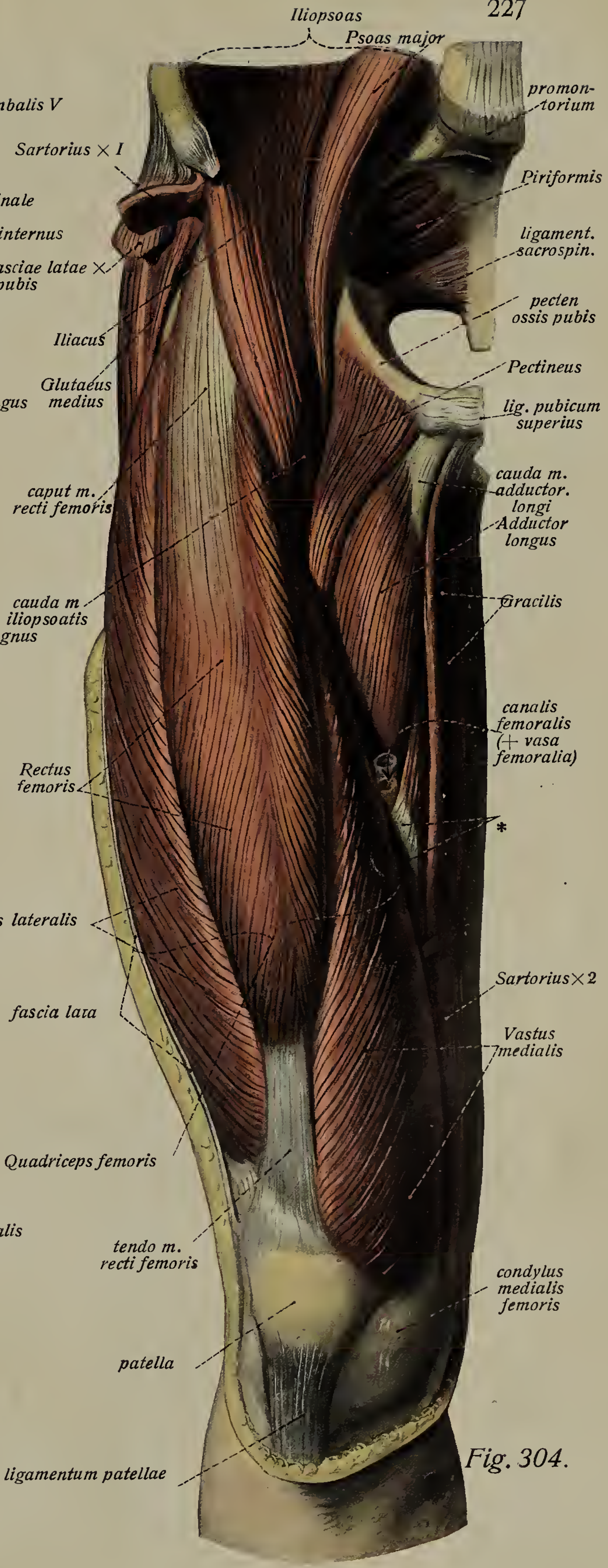


Fig. 304.

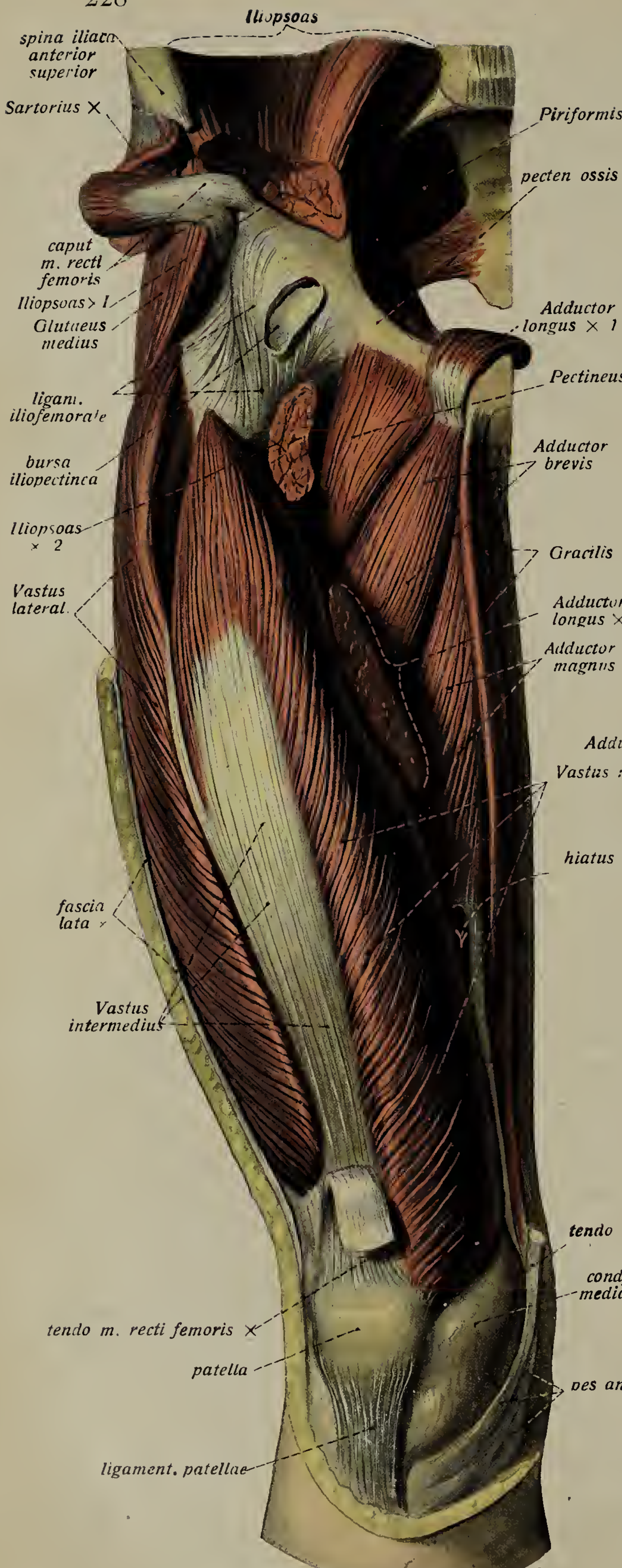


Fig. 305.

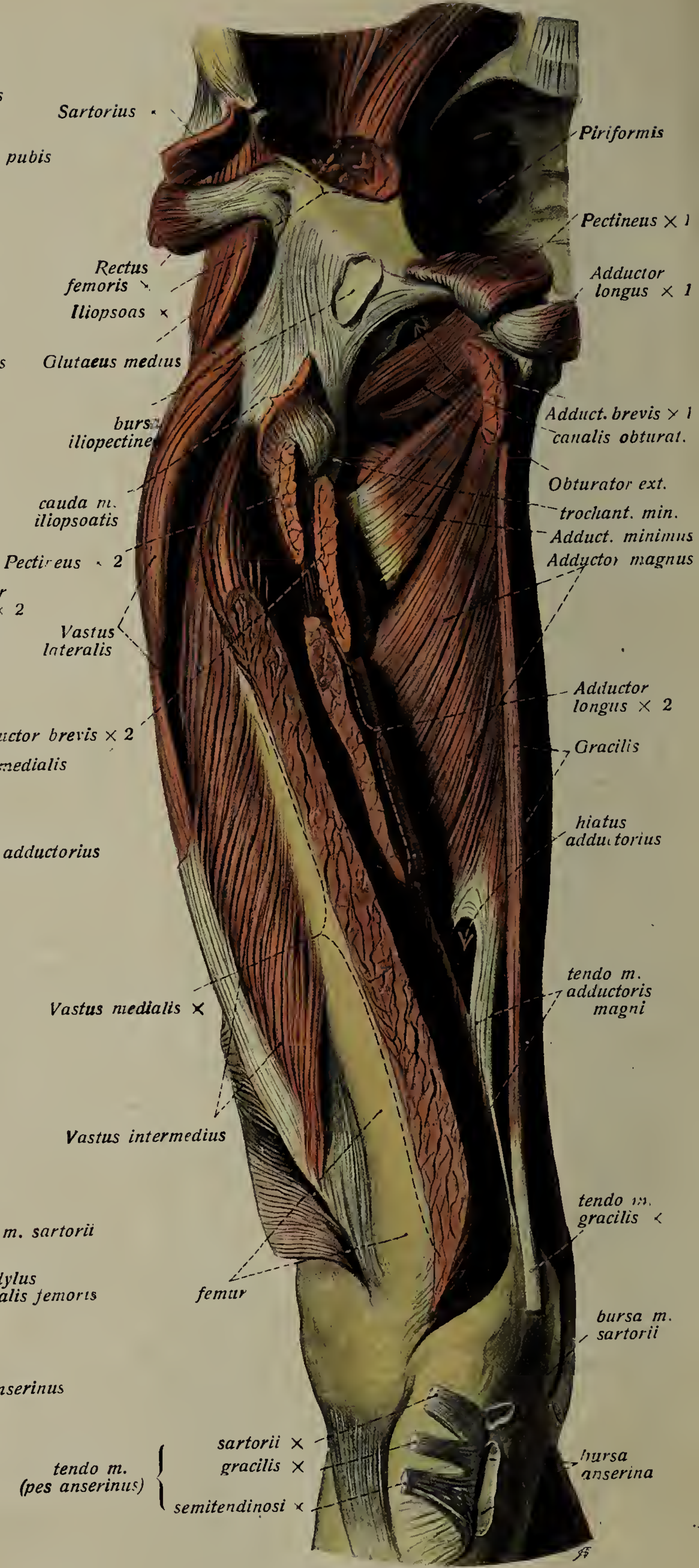


Fig. 306.

The Muscles of the Lower Extremity. (Cont.)

Fig. 305. The middle layer of muscles of the anterior surface of the thigh. (1/3)
The sartorius, iliopsoas, rectus and adductor longus have been cut away.

Fig. 306. The deep layer of muscles of the anterior surface of the thigh. (1/3).
Preparation as in Fig. 305, but the pectineus, adductor brevis, vastus medialis and gracilis are also cut away.

The Muscles of the Thigh. (Cont.) The Muscles of the Medial Surface.

The **Pectineus** arises from the pecten of the pubis and is inserted into the pectineal line of the femur. *Nerve:* The femoral. *Action:* Adducts the thigh and aids in flexion and external rotation.

The **Gracilis** arises from the pubis close to the symphysis and is inserted into the medial border of the tuberosity of the tibia. *Nerve:* The obturator. *Action:* Adducts the knee when lower leg is extended, aids in flexion at the knee and rotates the flexed knee inwards.

The **Adductor longus** arises from the junction of the upper and lower rami of the pubis and is inserted into the middle third of the medial lip of the linea aspera. *Nerve:* The obturator. *Action:* Adduction of thigh; assists in flexion.

The **Adductor brevis** arises from the upper ramus of the pubis, nearer to the obturator foramen than the adductor longus, and is inserted into the upper third of the medial lip of the linea aspera. *Nerve:* The obturator. *Action:* Adduction of the thigh; assists in flexion.

The **Adductor magnus** arises from the lower rami of the pubis and ischium and from the lower border of the ischial tuberosity. The portion arising from the lower ramus of the pubis is sometimes termed the **Adductor minimus.** The muscle inserts into the medial lip of the linea aspera, from the medial epicondyle to near the gluteal tuberosity. The lower part of the tendon is pierced by the *adductor hiatus. Nerve:* The obturator and sciatic (tibial). *Action:* Adducts the thigh.

The **Obturator externus** arises from the outer surface of the circumference of the obturator foramen and from the obturator membrane. It inserts into the trochanteric fossa of the femur. *Nerve:* The obturator. *Action:* External rotator of the femur; aids in adduction and flexion.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Thigh.

Fig. 307. The deep layer of the muscles of the rump and the superficial flexors of the thigh. (1/3)

The glutaeus maximus and medius have been cut away.

Fig. 308. The deep layer of rump muscles and the deep flexors of the thigh. (1/3)

In addition to the glutaeus maximus and medius, the quadratus femoris, obturator internus, long head of biceps, and semitendinosus have been cut away. * = great sciatic foramen, the infrapiriform part. ** = bursa of glutaeus medius.

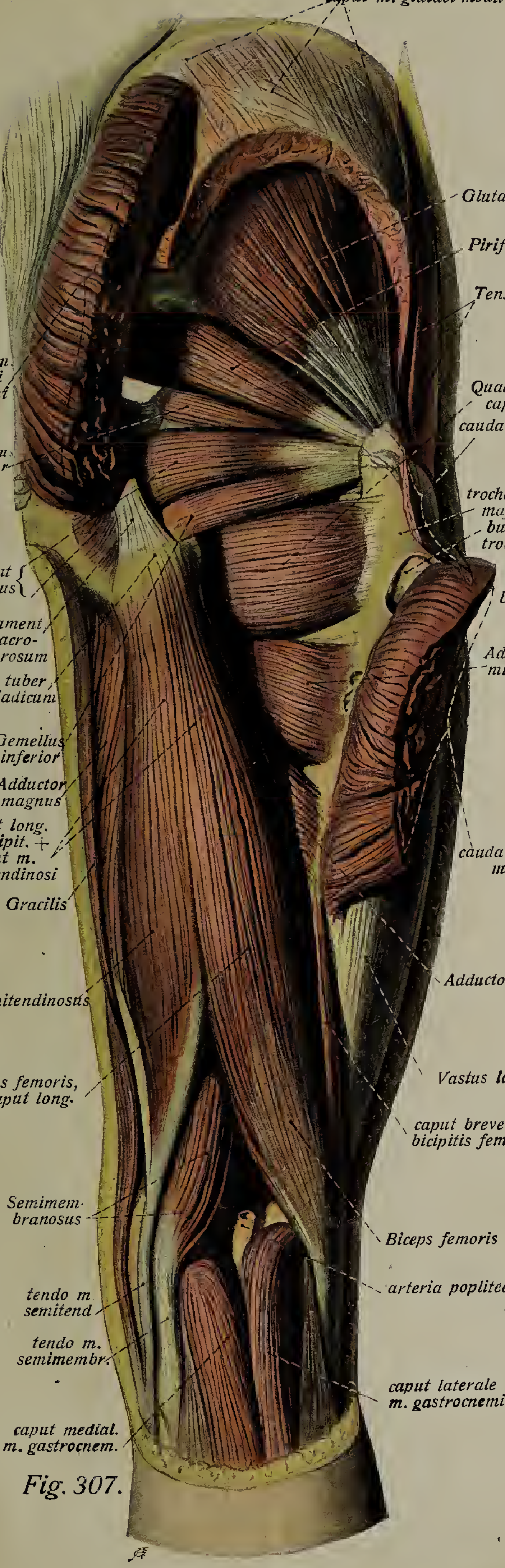
The Muscles of the Posterior Surface (Flexors).

The **Biceps femoris** arises by its *long head* from the tuberosity of the ischium and by its *short head* from the lower half of the lateral lip of the linea aspera. It is inserted into the head of the fibula. *Nerve:* The long head by the tibial, the short head by the peroneal. *Action:* flexion of the lower leg and extension of the thigh, together with the external rotation.

The **Semitendinosus** arises from the tuberosity of the ischium, with the long head of the biceps, and is inserted into the medial border of the tuberosity of the tibia, forming part of the pes anserinus. *Nerve:* The tibial. *Action:* Flexion of the lower leg, together with internal rotation. Extension of the thigh.

The **Semimembranosus** arises from the tuberosity of the ischium and is inserted into the posterior part of the medial condyle of the tibia and into the oblique popliteal ligament. *Nerve:* The tibial. *Action:* Flexion of the lower leg; extension of the thigh.

Where the glutaeus maximus passes over the great trochanter a *trochanteric bursa* is interposed and lower down one or several *glutaeo-femoral bursae.* Under the insertion of the glutaeus medius there is a bursa, and, similarly, under that of the glutaeus minimus. Where the obturator internus tendon passes at an acute angle over the lesser sciatic notch there is an elongated bursa. Between the ilio-psoas and the ilio-femoral ligament there is an *ilio-pectineal* bursa that occasionally communicates with the hip joint.



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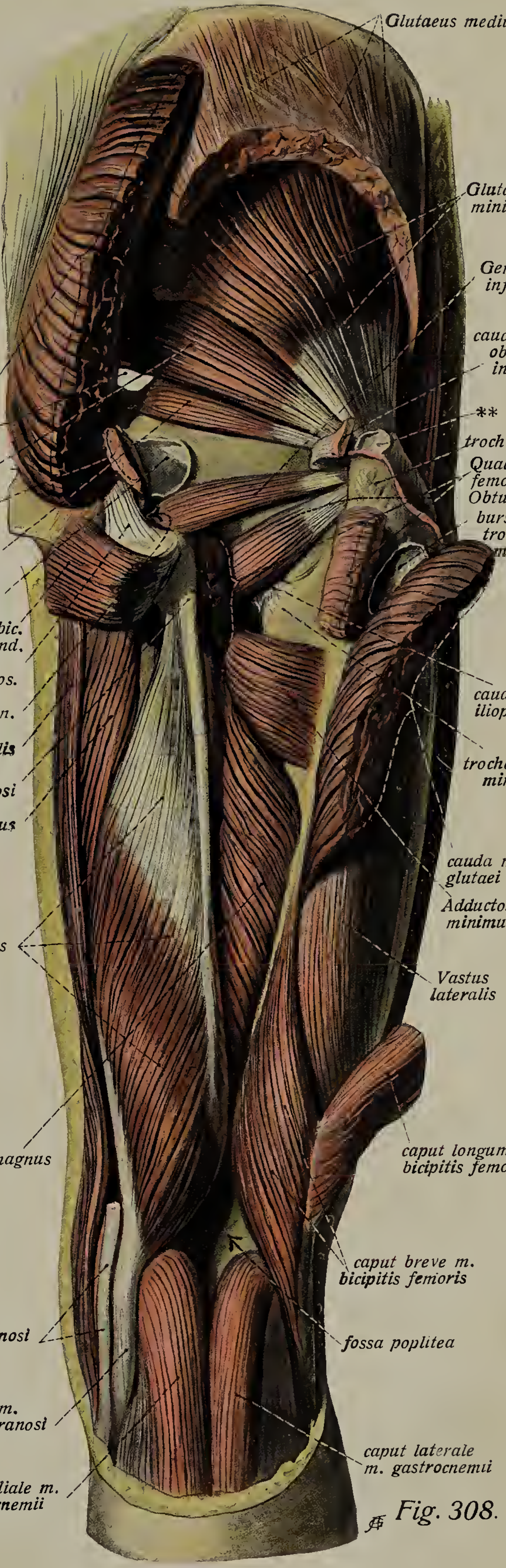

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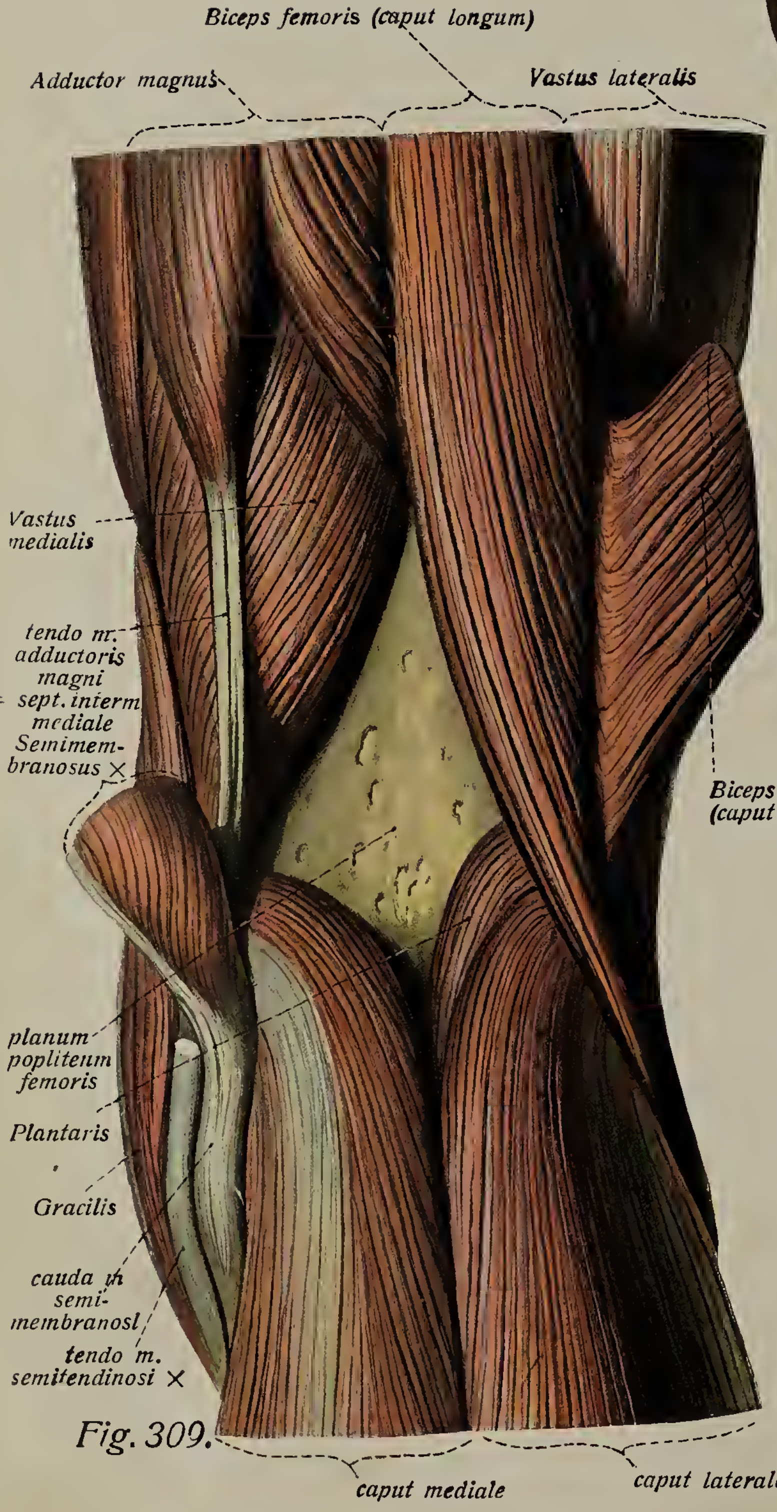


Fig. 309.

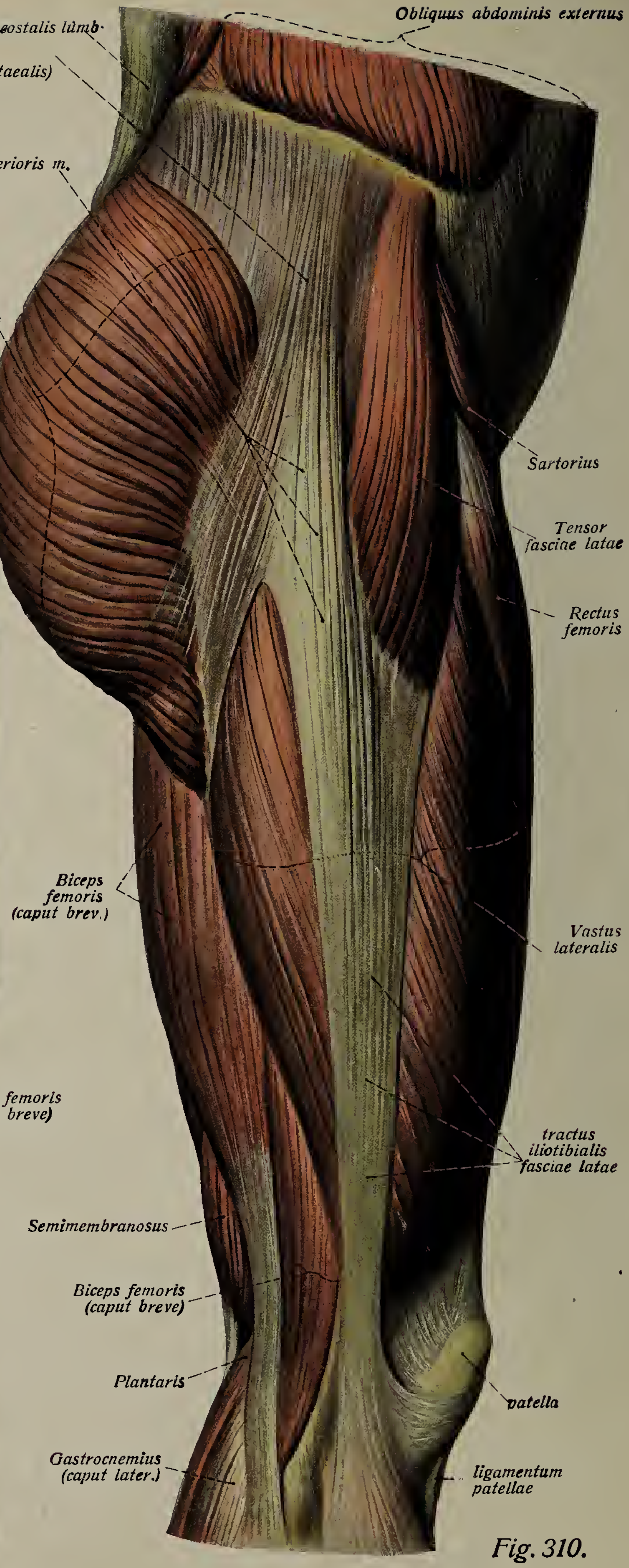

tendo m. longissimi dorsi + m. iliocostalis lumb.
Obliquus abdominis externus
fascia lata (fascia glutaealis)
fascia lata (cauda partis superioris m. glutaei maximi)
Glutaeus maximus
Sartorius
Tensor fasciae latae
Rectus femoris
Biceps femoris (caput brev.)
Vastus lateralis
tractus iliotibialis fasciae latae
Semimembranosus
Biceps femoris (caput breve)
Plantaris
patella
Gastrocnemius (caput later.)
ligamentum patellae

Fig. 310.

The Muscles of the Lower Extremity. (Cont.)

Fig. 309. The muscles in the region of the popliteal space, after the semimembranosus, semitendinosus and long head of the biceps have been cut away. ($^1/_2$)

Fig. 310. The superficial muscles of the thigh from the outer side. ($^1/_3$)

The Fasciae of the Lower Extremity (cont. from p. 225).

On the posterior surface of the thigh the fascia lata covers the glutaeus maximus by its superficial layer, here quite thin, the deep layer passing beneath the muscle; on the part of the glutaeus medius that is not covered by the maximus, the fascia forms a dense aponeurotic sheet *(fascia glutaea)*. Some strong transverse fibres run in the gluteal groove at the lower border of the maximus. Over the flexor muscles the fascia lata is of moderate strength and shows predominating transverse fibres, which become especially developed in the region of the popliteal fossa, whose roof is formed by the fascia lata.

The strongest part of the fascia lata occurs on the lateral surface of the thigh; it is the *ilio-tibial band (tractus)* and is formed mainly of strong tendinous longitudinal bundles of fibres, which are attached below to the lateral condyle of the tibia. Between the groups of thigh muscles the fascia in the lower part of the thigh sends in to the lips of the linea aspera a *medial* and a *lateral intermuscular septum*, the medial becoming continuous with the tendon of the adductor magnus. On the anterior surface of the thigh the fascia is divided in its upper part into two layers; the superficial one covers the surface of the sartorius and the femoral vessels, the deeper one passes behind the sartorius, lines the ilio-pectineal fossa and the furrow between the vestus medialis and the adductors. Over the adductors the fascia is thin. The portion covering the pectineus is termed the *pectineal fascia;* it unites with the lower end of the *iliac fascia* to form the *ilio-pectineal fascia* which lines the floor of the ilio-pectineal fossa.

The *crural-fascia* invests the muscles of the lower leg and covers the muscle-free medial surface of the tibia. It is strongest anteriorly below the knee joint, where it fuses with the extensor and peroneal muscles and with the tendons of the pes anserinus. It sends the *anterior intermuscular septum* to the anterior crest of the fibula between the extensors and the peronaei, and the *posterior intermuscular septum* to the lateral crest of the fibula, between the peronaei and the flexors. On the posterior surface of the lower leg it splits into a superficial and a deep layer, the former covering the triceps surae, the latter the deep group of flexors. A special thickening of the crural fascia, in addition to those forming the retinacula (see p. 246), is the *transverse crural ligament*, which passes transversely between the tibia and fibula above the ankle joint.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Lower Leg.

The Muscles of the Posterior Surface.

Fig. 311. The superficial layer of muscles of the calf. ($^1/_3$)

Fig. 312. The second layer of the muscles of the calf. ($^1/_3$) The gastrocnemius is cut and reflected, the deep layer of the crural fascia is removed down to the laciniate ligament and the peroneal retinaculum.

The **Gastrocnemius,** which has two heads, together with the soleus forms a muscle mass sometimes termed the *triceps surae.* The gastrocnemius arises by its *medial head* from the medial condyle of the femur and by its *lateral head* from the lateral condyle. The two heads unite together and at about the middle of the lower leg the muscle unites with the soleus lying beneath it. The **Soleus** takes its origin from the head, posterior surface and lateral crest of the fibula, from a tendinous arch between the tibia and fibula over the popliteal vessels and from the posterior surface of the tibia at and below the popliteal line. The muscle unites with the gastrocnemius to form a powerful tendon *(tendo Achillis)* which is inserted into the tuberosity of the calcaneus. *Nerve:* The tibial. *Action:* Plantar flexion of the foot and elevation of the inner border.

The **Plantaris** is a small muscle with a long slender tendon. It arises from the lateral condyle of the femur and is inserted at the heel into the deep layer of the crural fascia and the tendo Achillis. *Nerve:* Tibial. *Action:* Tenses the tendo Achillis.

The **Popliteus** arises from the lateral condyle of the femur and from the arcuate popliteal ligament and is inserted into the posterior surface of the tibia above the popliteal line. *Nerve:* The tibial. *Action:* Tenses the capsule of the knee; when the knee is bent rotates it inwards.

A bursa lies beneath the origin of the medial head of the gastrocnemius and another beneath the origin of the semimembranosus; both may communicate with the knee joint. A popliteal bursa, beneath the origin of the popliteus, also communicates with the knee joint.

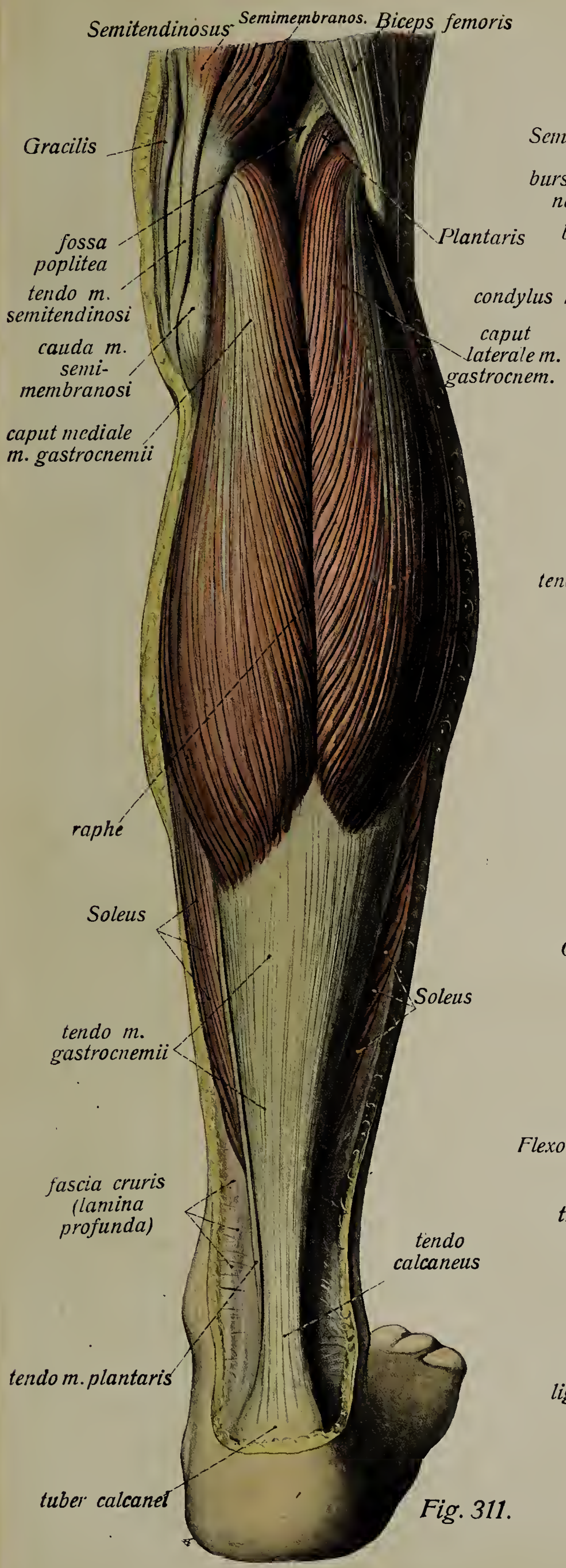
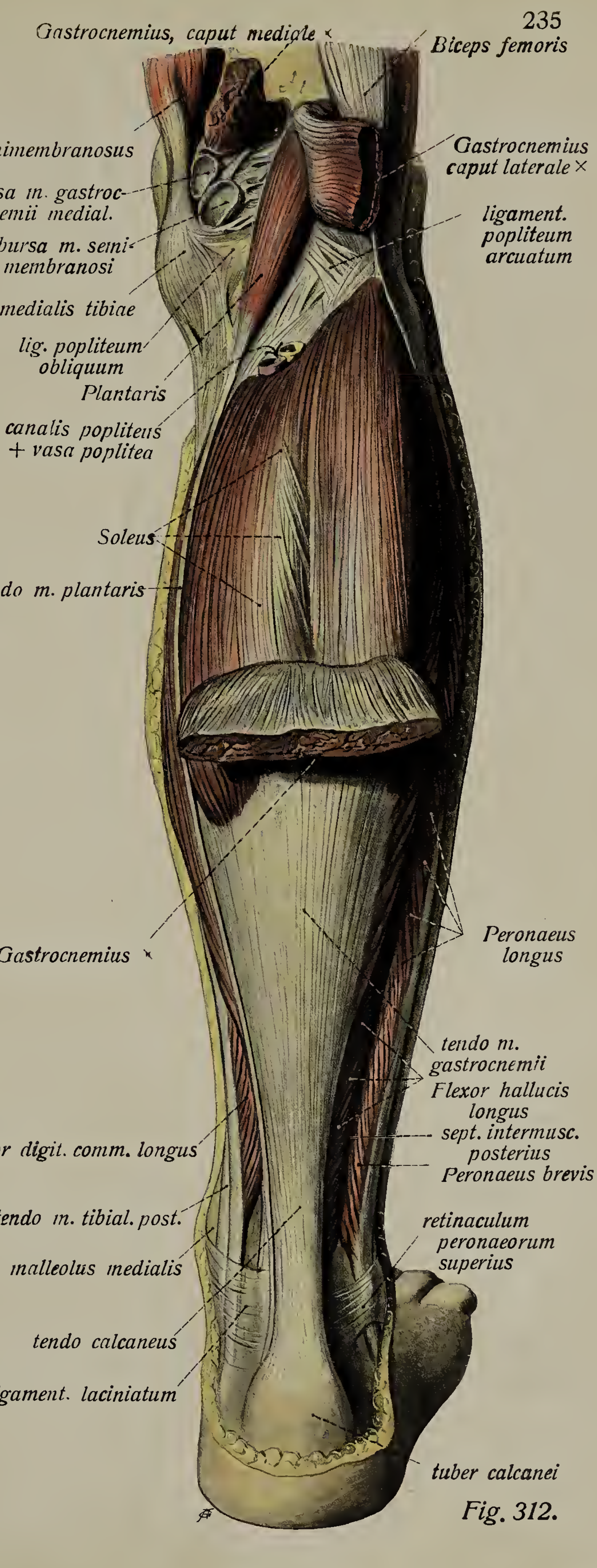


Fig. 311.



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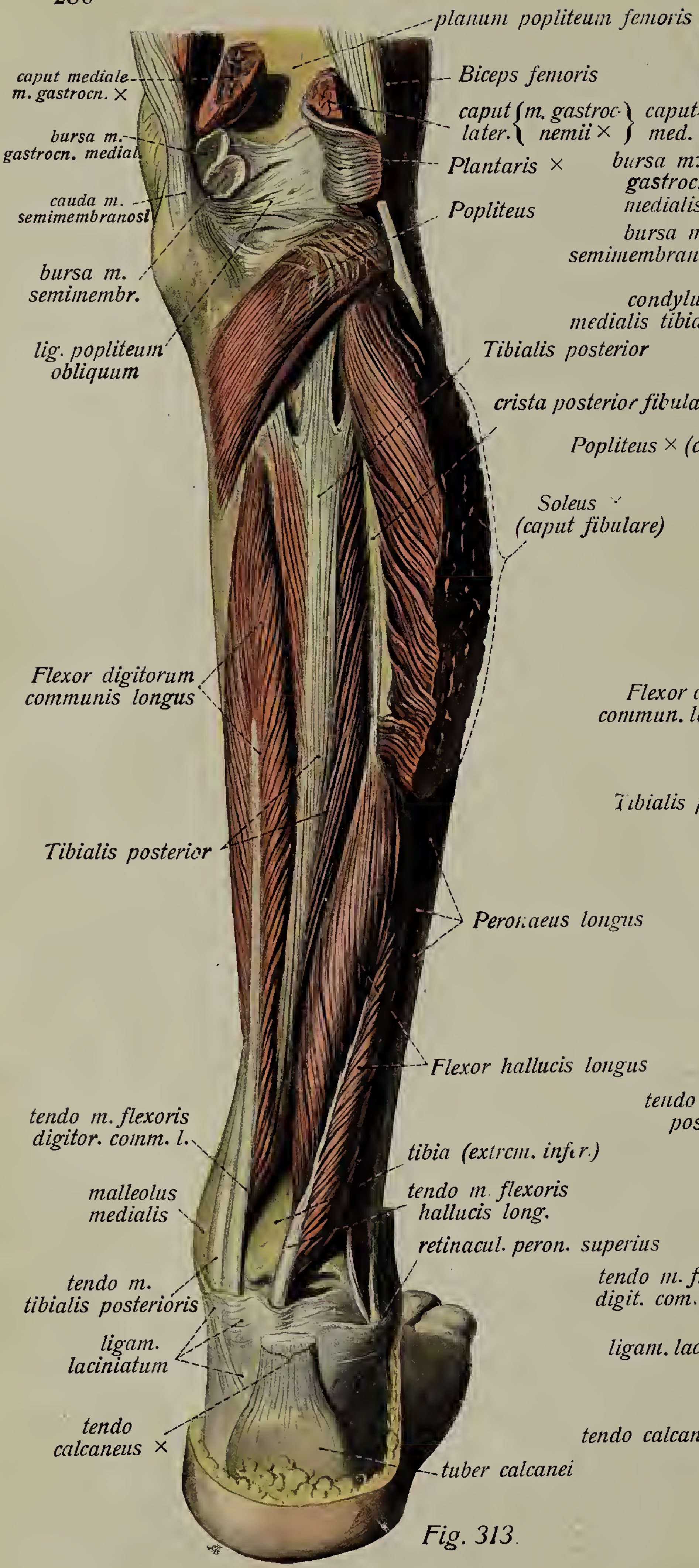

Fig. 313.

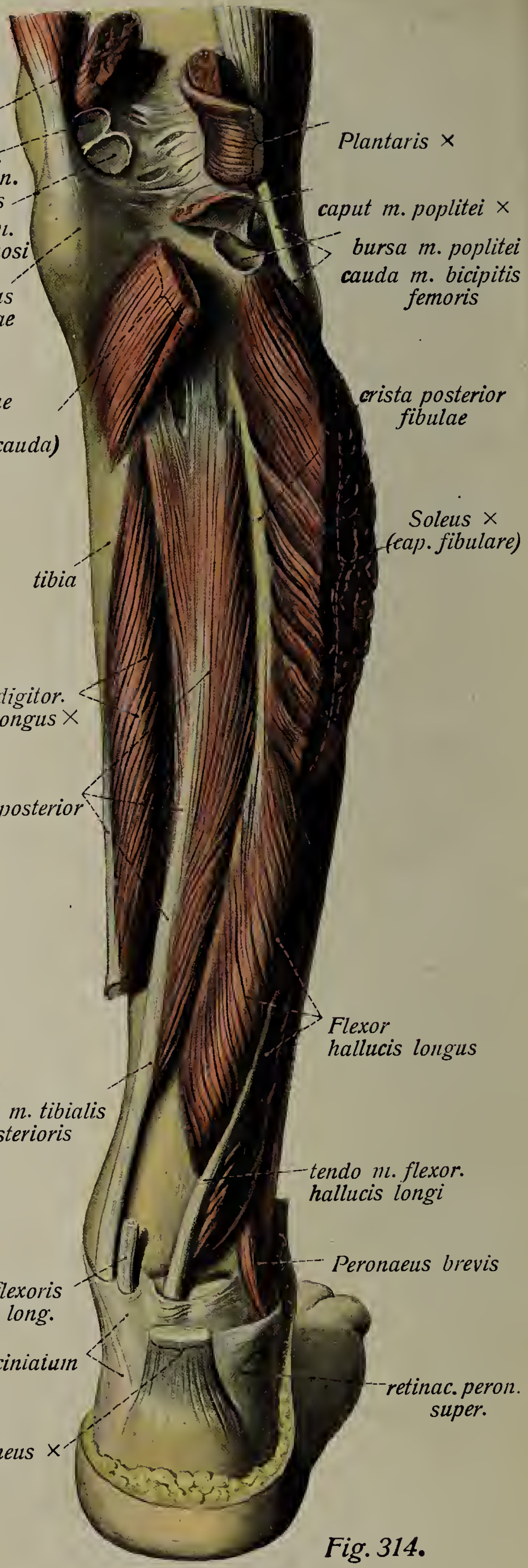

Fig. 314.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Lower Leg. (Cont.)

The Muscles of the Posterior Surface, Deep Layer.

Fig. 313. The deep muscles of the calf. ($^1/_3$).
The gastrocnemius, soleus and plantaris are cut away.

Fig. 314. The deepest layer of the calf muscles. ($^1/_3$)
Preparation as in Fig. 313, but, in addition, parts of the popliteus and flexor digitorum longus have been removed.

The **Tibialis posterior** arises from the upper part of the posterior surface of the tibia, from the interosseous membrane and the medial surface of the fibula. It inserts into the tuberosity of the navicular bone and the plantar surface of the first or all of the cuneiforms. *Nerve:* The tibial. *Action:* Plantar flexion and elevation of the inner border of the foot; fixes the head of the talus.

The **Flexor digitorum longus** arises from the posterior surface and interosseous crest of the tibia. It divides into four tendons which insert into the terminal phalanges of the four lateral toes. *Nerve:* The tibial. *Action:* Flexes the four lateral toes, assists in plantar flexion and supination.

The **Flexor hallucis longus** arises from the posterior surface and the lower two-thirds of the lateral crest of the fibula and from the interosseous membrane. It inserts into the terminal phalanx of the great toe. *Nerve:* The tibial. *Action:* Flexes the great toe and assists in flexing and supinating the foot.

The tendons of the Flexor digitorum longus and Tibialis posterior cross one another above the medial malleolus, so that that of the latter muscle is the more medial at the level of the laciniate ligaments (see Fig. 324, p. 247). On the sole of the foot there is a crossing of the tendons of the Flexor hallucis longus and Flexor digitorum longus, by which both tendons fuse, so that the strong Flexor hallucis acts not only upon the great toe, but also on the other four.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Lower Leg. (Cont.)

The Anterior (Extensor) and Lateral (Peroneal) Groups.

Fig. 315. The muscles of the anterior surface of the lower leg and the dorsum of the foot. ($^1/_3$)

The transverse crural ligament is removed but the cruciate ligament is retained.

Fig. 316. The muscles of the lower leg and dorsum of the foot from the side. ($^1/_3$)

The crural fascia is removed down to the retinacula.

The Anterior (Extensor) Group.

The **Tibialis anterior** arises from the lateral surface of the tibia, the interosseous membrane and the crural fascia. It inserts into the medial border of the base of the first metatarsal and into the plantar surface of the medial cuneiform. *Nerve:* The deep branch of peroneal. *Action:* Dorsal flexion and supination of the foot; elevation of its inner border.

The **Extensor hallucis longus** arises from the medial surface af the fibula, the interosseous membrane and the crural fascia. It is inserted into the dorsal surface of the great toe. The **Extensor digitorum longus** arises from the anterior crest of the fibula, the interosseous membrane and the crural fascia and inserts by four tendons into the dorsal aponeuroses of the four lateral toes. The **Peronaeus tertius** splits off from the lower part of the Extensor digitorum longus and is inserted into the dorsal surface of the fifth metacarpal. *Nerve:* The deep branch of the peroneal. *Action:* Extension of the toes; the peronaeus tertius assists in dorsal flexion of the foot, the extensors in supination.

The Lateral (Peroneal) Group.

The **Peronaeus longus** arises from the head of the fibula, the crural fascia, the upper two-thirds of the lateral surface and lateral crest of the fibula. It passes across the sole of the foot in the peroneal groove and is inserted into the tuberosity of the first metatarsal. The **Peronaeus brevis** arises from the lower half of the lateral surface and the interior crest of the fibula and inserts into the tuberosity of the fifth metatarsal, sending prolongations to the fifth toe. *Nerve:* Both peronaei are supplied by the superficial branch of the peroneal. *Action:* Abduct and pronate the foot and assist in plantar flexion.

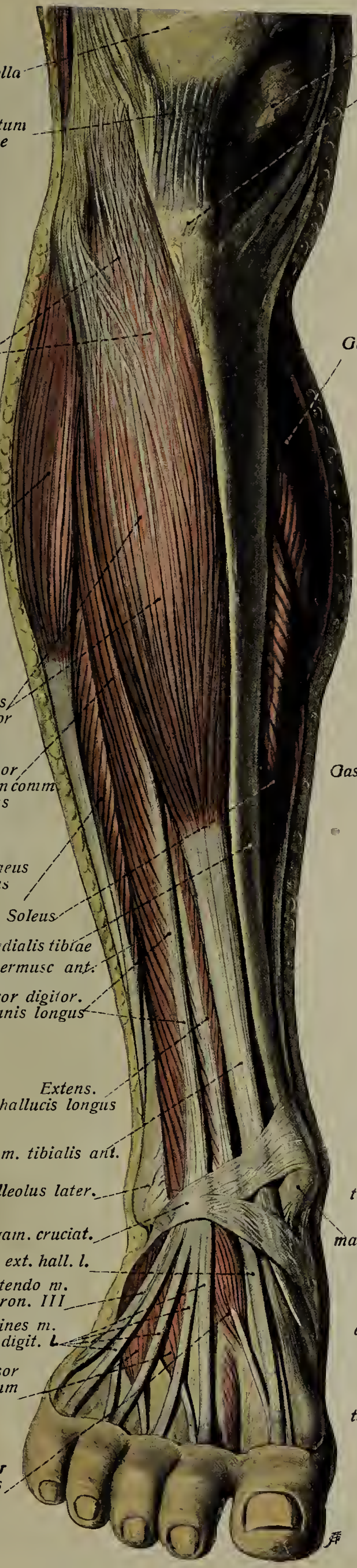

Fig. 315.

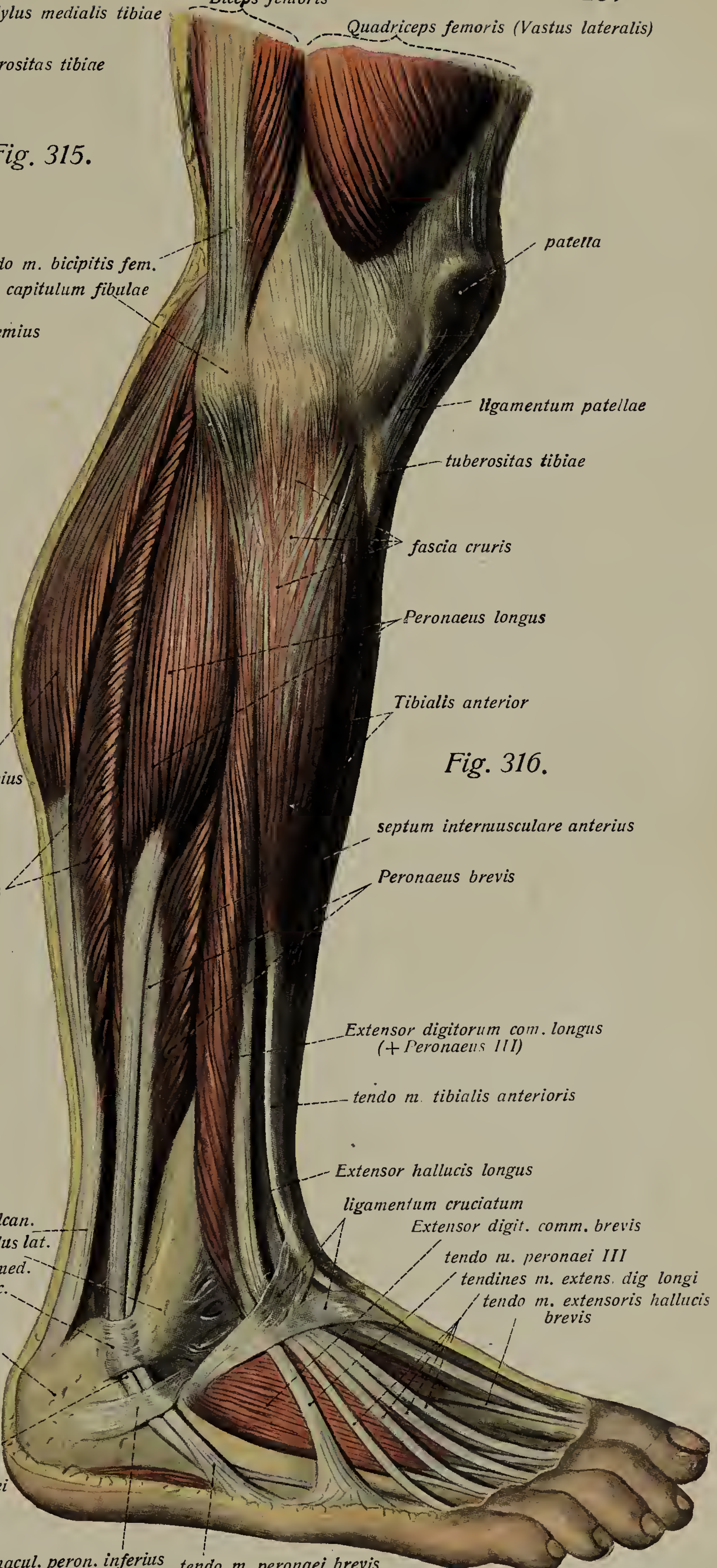

Fig. 316.

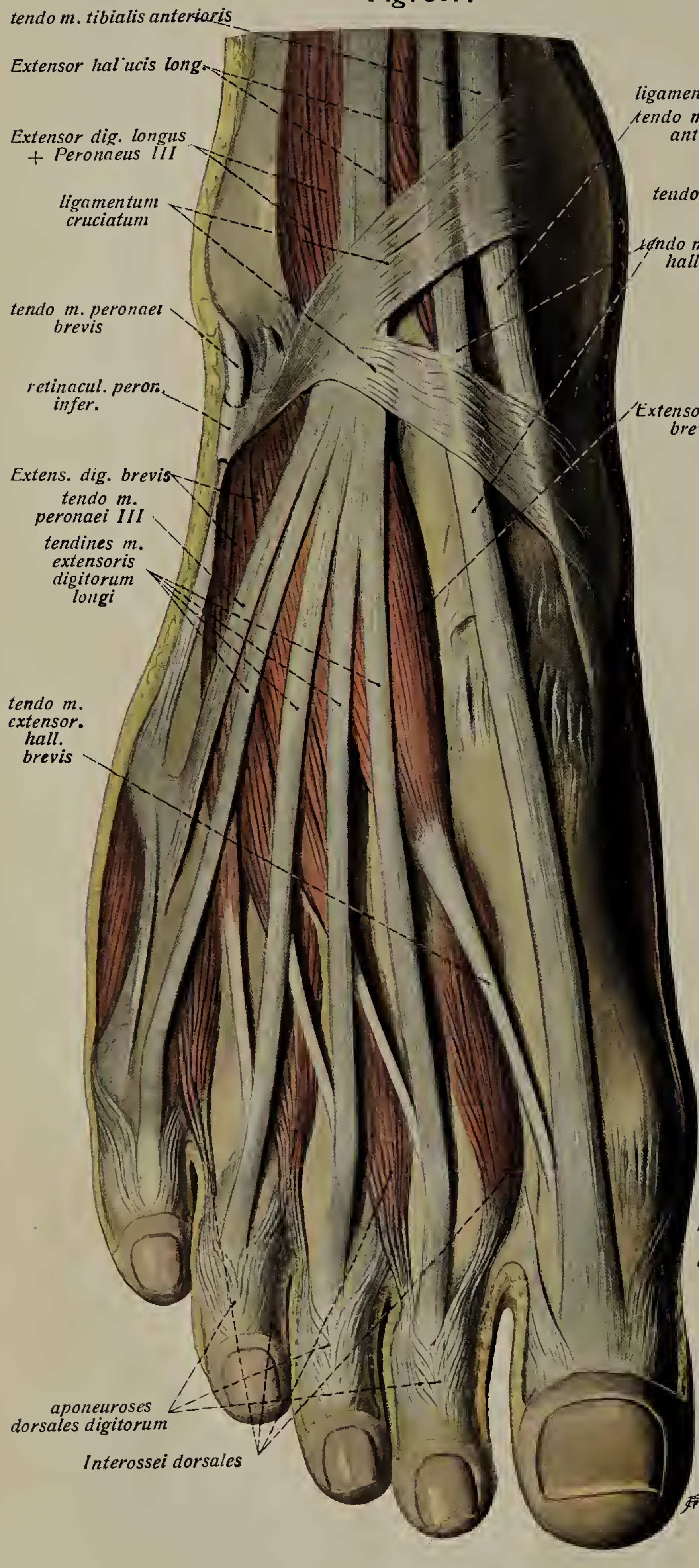

Fig. 317.

tendo m. tibialis anterioris
Extensor hallucis long.
Extensor dig. longus + Peronaeus III
ligamentum cruciatum
tendo m. peronaei brevis
retinacul. peron. infer.
Extens. dig. brevis
tendo m. peronaei III
tendines m. extensoris digitorum longi
tendo m. extensor. hall. brevis
aponeuroses dorsales digitorum
Interossei dorsales
tendo m. tibialis anterioris
tendo m. extensoris hallucis longi
Extensor hallucis brevis

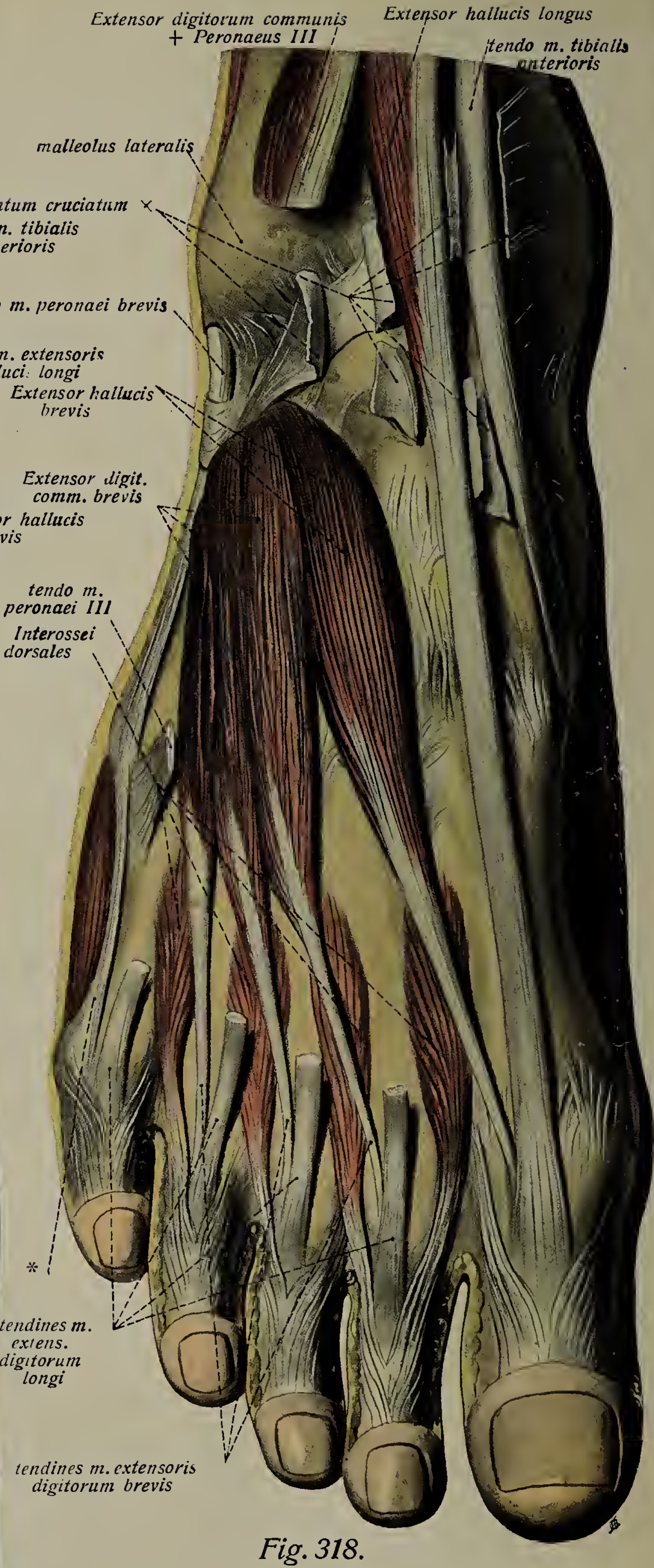

Fig. 318.

Extensor digitorum communis + Peronaeus III
Extensor hallucis longus
tendo m. tibialis anterioris
malleolus lateralis
ligamentum cruciatum ×
tendo m. peronaei brevis
Extensor hallucis brevis
Extensor digit. comm. brevis
tendo m. peronaei III
Interossei dorsales
*
tendines m. extens. digitorum longi
tendines m. extensoris digitorum brevis

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Foot. Muscles of the Dorsum pedis.

Fig. 317. The superficial muscles and tendons of the dorsum of the foot. ($^2/_3$)
Fig. 318. The deep layer of muscles and tendons of the dorsum of the foot. ($^2/_3$)
The cruciate ligament is removed. * = continuation of the tendon of the peronaeus brevis to the little toe.

The **Extensor digitorum brevis** arises from the dorsal and lateral surfaces of the calcaneus, anterior to the sinus tarsi. It passes by three slender tendons into the dorsal aponeurosis of the three middle toes. The **Extensor hallucis brevis** arises from the dorsal surface of the calcaneus and inserts into the dorsal aponeurosis of the great toe. *Nerve:* The deep branch of the peroneal. *Action:* Extensors of the toes.

The Fascia of the Foot.

While the *dorsal fascia* of the foot is an unimportant thin sheet, the *plantar aponeurosis* is the strongest of all the fasciae of the leg. At the middle of the sole of the foot it is a thick, tendinous sheet, whose bundles are chiefly longitudinal, but have an oblique direction towards the borders of the foot. The proximal part of the aponeurosis is firmly united to the long plantar muscles and arises with them from the medial and lateral processes of the calcaneal tuberosity; it is much thicker than the distal portion. With this, it presents three *plantar eminences*, *medial*, *lateral* and *intermediate*. A fibular portion covering the Abductor digiti quinti may be distinguished from the broader tibial portion covering chiefly the Flexor digitorum brevis. From the aponeurosis numerous fine bundles pass to the skin. Towards the toes the tibial part of the aponeurosis divides into several processes, which practically agree in number with the toes, but transverse fasciculi are hardly noticeable. In the toes the prolongations of the aponeurosis are lost in the connective tissue of the skin.

The Muscles of the Lower Extremity. (Cont.)

The Plantar Muscles.

Fig. 319. The plantar aponeurosis. ($^2/_3$)
* = prolongations to the toes.

Fig. 320. The superficial plantar muscles. ($^2/_3$)
The plantar aponeurosis has been partly removed.

The **Flexor digitorum brevis** arises from the medial process of the calcaneal tuberosity and from the plantar aponeurosis. It inserts by four tendons, which are perforated by the tendons of the long flexor, into the middle phalanges of the four lateral toes. *Nerve:* The medial plantar. *Action:* Flexes the toes.

The **Quadratus plantae** arises by two heads from the plantar surface of the calcaneus and from the long plantar ligament. It is inserted into the tendon of the Flexor digitorum longus. *Nerve:* The lateral plantar. *Action:* Assists the flexor digitorum longus, correcting its oblique pull.

The Muscles of the Great Toe.

The **Abductor hallucis** arises from the medial process of the calcaneal tuberosity and from the plantar aponeurosis. It inserts by means of the medial sesamoid bone into the basal phalanx of the great toe. The **Flexor brevis hallucis** arises from the plantar surfaces of the second and third cuneiforms and from the long plantar ligaments. It is inserted by two heads into two sesamoid bones and the basal phalanx of the great toe. The **Adductor hallucis** consists of two distinct portions. The *oblique head* arises from the plantar surface of the third (lateral) cuneiform and the plantar ligament. The *transverse head* arises from the tarso-metatarsal joints of the fifth to the third toe. It is inserted into the lateral sesamoid bone and basal phalanx of the great toe. *Nerves:* For the Abductor and Flexor brevis the medial plantar; for the Adductor and part of the Flexor the lateral plantar. *Action:* Adduction and flexion of the great toe.

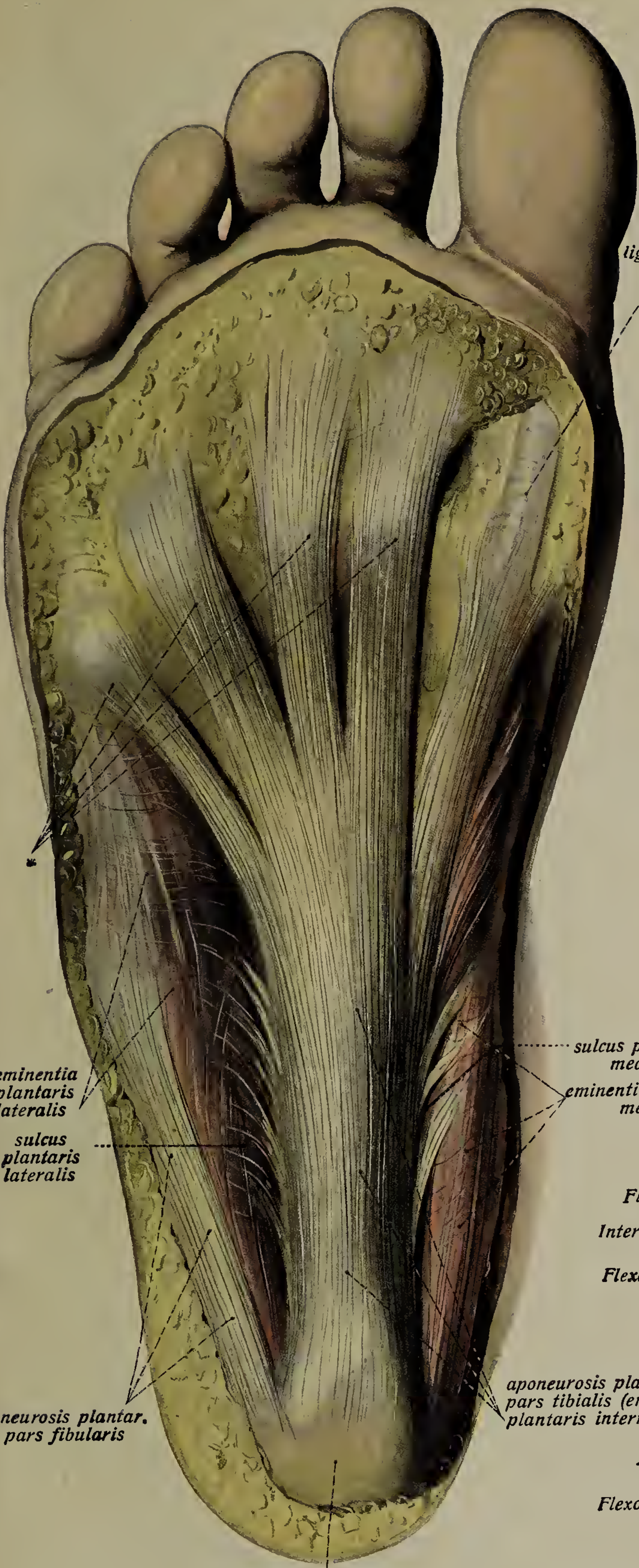
vagina tendinis m. flexoris hall. l.
sulcus plantaris medialis
eminentia plantaris medialis
eminentia plantaris lateralis
sulcus plantaris lateralis
aponeurosis plantaris, pars tibialis (eminentia plantaris intermedia)
poneurosis plantar. pars fibularis
tuber calcanei

Fig. 319.

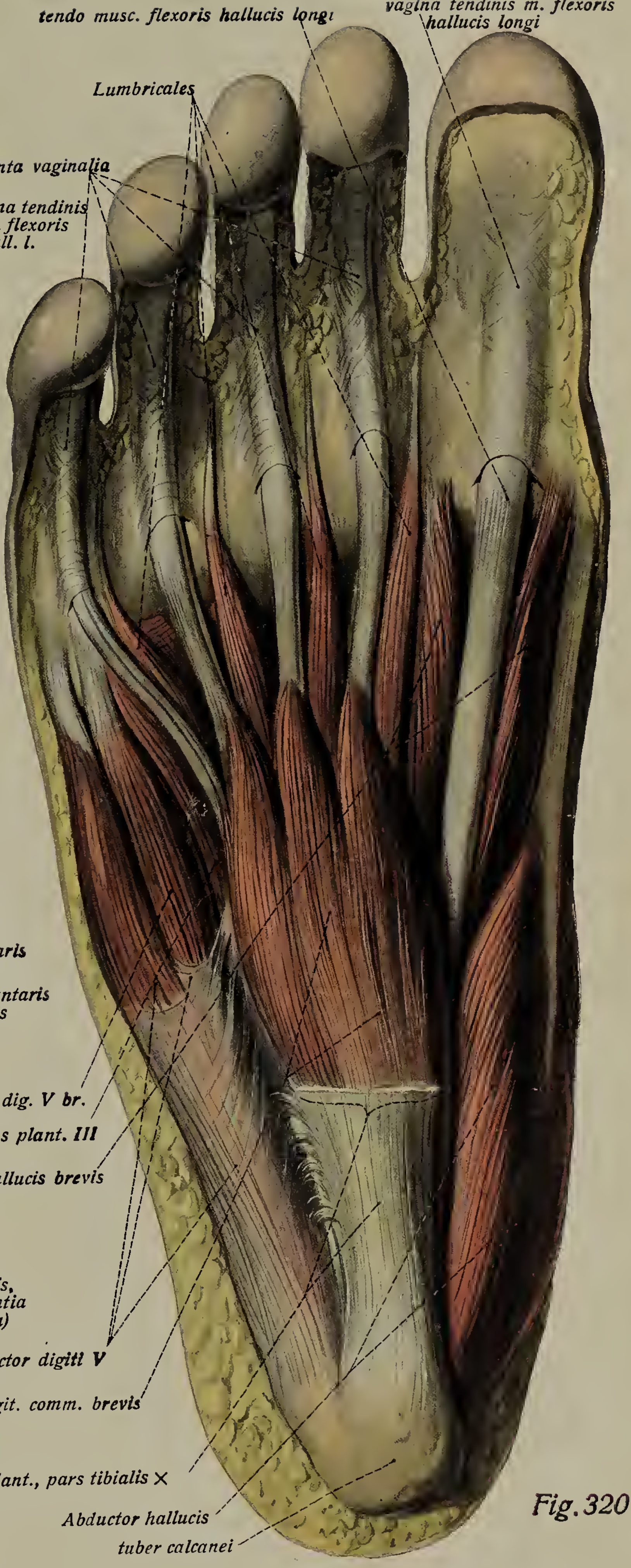

Fig. 320

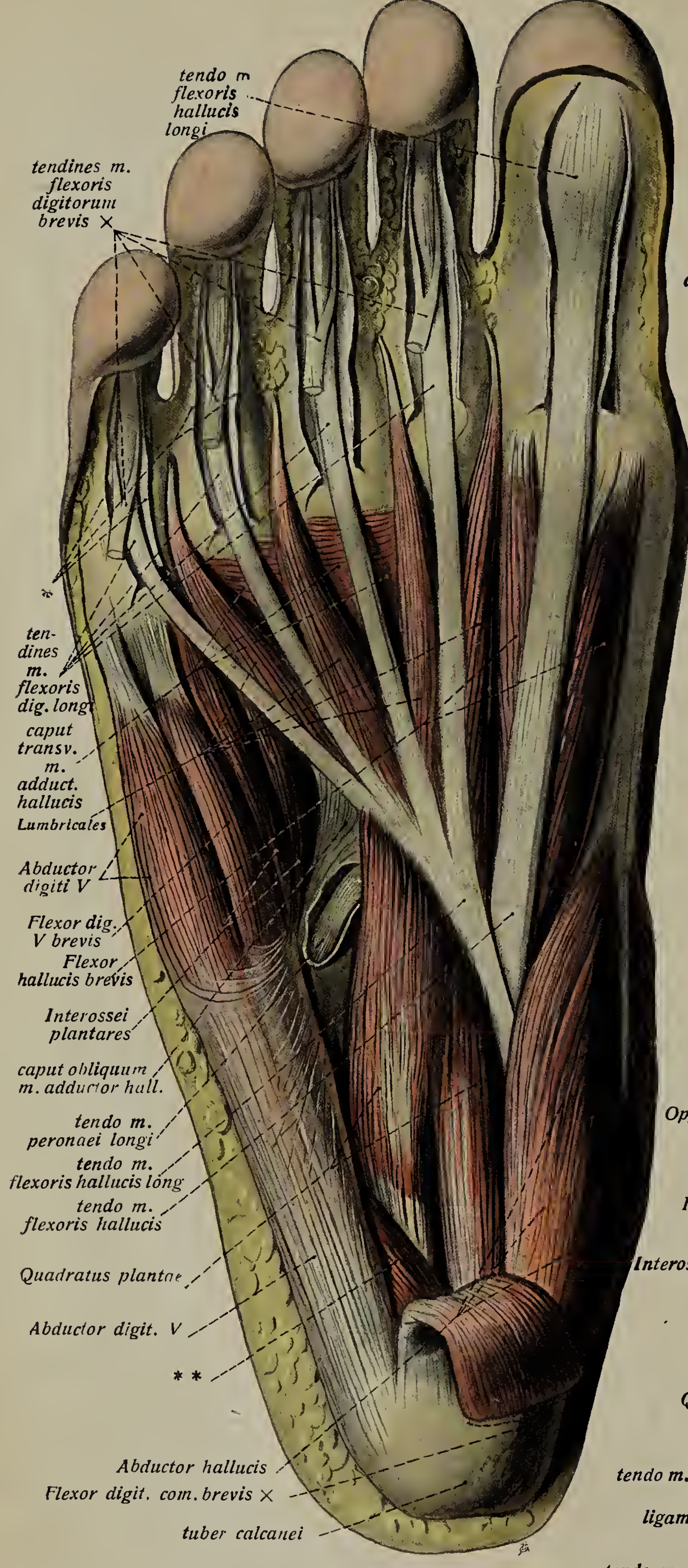
tendo m. flexoris hallucis longi
tendines m. flexoris digitorum brevis ×
tendines m. flexoris dig. longi
caput transv. m. adduct. hallucis
Lumbricales
Abductor digiti V
Flexor dig. V brevis
Flexor hallucis brevis
Interossei plantares
caput obliquum m. adductor hall.
tendo m. peronaei longi
tendo m. flexoris hallucis long
tendo m. flexoris hallucis
Quadratus plantae
Abductor digit. V
* *
Abductor hallucis
Flexor digit. com. brevis ×
tuber calcanei

Fig. 321.

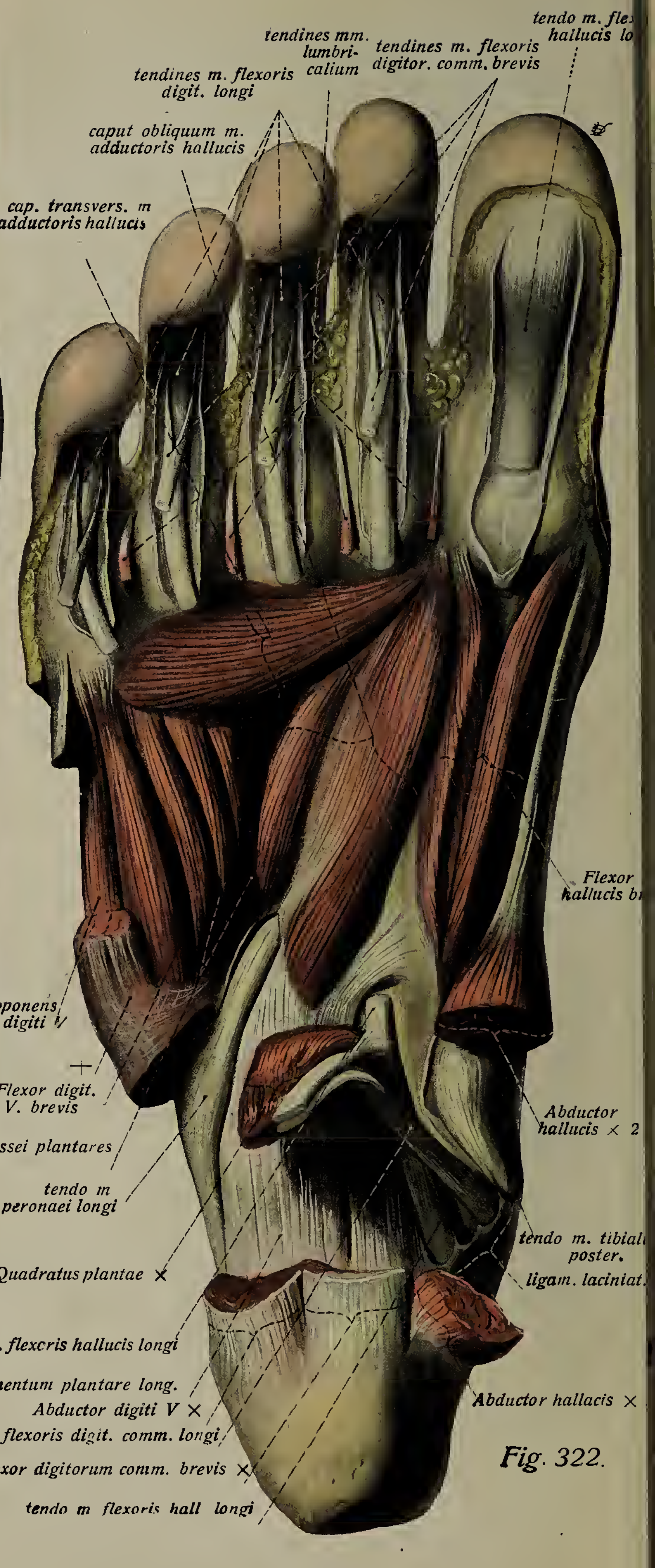
tendo m. fle
hallucis lo
tendines mm. lumbricalium
tendines m. flexoris digitor. comm. brevis
tendines m. flexoris digit. longi
caput obliquum m. adductoris hallucis
cap. transvers. m adductoris hallucis
Flexor hallucis b
Opponens digiti V
+
Flexor digit. V. brevis
Interossei plantares
tendo m peronaei longi
Abductor hallucis × 2
tendo m. tibiali poster.
ligam. laciniat.
Quadratus plantae ×
tendo m. flexcris hallucis longi
ligamentum plantare long.
Abductor digiti V ×
tendo m. flexoris digit. comm. longi
Flexor digitorum comm. brevis ×
tendo m flexoris hall longi
Abductor hallacis ×

Fig. 322.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Foot (Cont.)

The Plantar Muscles. (Cont.) The Muscles of the Little Toe.

Fig. 321. The middle layer of plantar muscles. ($^2/_3$).

The flexor digitorum brevis is partly removed, the tendon sheath of the peronaeus longus and those of the toes are opened. * = tendon sheaths of the toes opened. ** = deep head of abductor digiti V.

Fig. 322. The deep layer of the plantar muscles. ($^2/_3$)

In addition to the flexor digitorum brevis the following are cut away; tendons of flexor digitorum longus, quadratus plantae, abductor digiti V, abductor hallucis and tendon of the flexor hallucis longus. + = insertion of Abductor digiti V into the tuberosity of the fifth metatarsal.

The **Abductor digiti quinti** arises from the lateral process of the tuberosity of the calcaneus and from the plantar aponeurosis, further, by a deep head, from the medial process of the calcaneal tuberosity. It inserts into the lateral border of the basal phalanx of the little toe and into the tuberosity of the fifth metatarsal. The **Flexor digiti quinti brevis** and the **Opponens digiti quinti** arise in common from the anterior part of the long plantar ligament. The Flexor inserts into the basal phalanx of the little toe, the Opponens into the lateral border of the fifth metatarsal. *Nerve:* The lateral plantar. *Action:* Abduction, flexion and opposition of little toe.

The **Lumbricals** of the foot arise from the tendons of the Flexor digitorum longus, the first by a simple head from the medial edge of the first (medial) tendon, the other three by two heads. In the region of the metatarso-phalangeal joint they pass to the medial side of the dorsal aponeurosis of the four lateral toes. At their points of insertion there are usually small bursae. *Nerves:* They are supplied in a variable manner by the medial and lateral plantars. *Action:* Flexion of the basal phalanges and extension of the others.

The **Interossei** (see p. 248) are seven in number, four Dorsal and three Plantar. They occupy the inter-metatarsal spaces and the plantar arise by a simple head, the dorsal by two. The first dorsal inserts into the dorsal aponeurosis of the second toe on the tibial side, the other three into the fibular side of the aponeurosis of the second, third and fourth toes. The plantar insert into the tibial side of the aponeurosis of the third, fourth and fifth toes. *Nerve:* The lateral plantar. *Action:* Flexion of basal phalanges, extension of the others.

The dorsal aponeurosis of the toes, like those of the fingers, are formed by the tendons of the Extensor brevis and Extensor longus, those of the interossei and those of the lumbricales.

The Muscles of the Lower Extremity. (Cont.)

The Muscles of the Foot.

The Tendon Sheaths of the Foot.

Fig. 323. The tendon sheaths of the region of the lateral malleolus and dorsum of the foot. (${}^1/_1$)

Fig. 324. The tendon sheaths in the neighborhood of the medial malleolus, of the sole and dorsum of the foot. (${}^1/_1$)
The abductor hallucis and flexor digitorum brevis are partly cut away.

The Tendon Sheaths of the Region of the Malleolus.

The three groups of muscles passing from the lower leg into the foot have their tendons invested by tendon sheaths, which, like those of the upper extremity, are protected by retinacula. For the two Peronaei there is a double retinaculum, which is actually a thickening of the deep layer of the lateral portion of the crural fascia. The *superior peroneal retinaculum* extends from the neighborhood of the lateral malleolus to the calcaneus, the *inferior peroneal retinaculum* from the neighborhood of the trochlear process of the calcaneus, above which it blends with the cruciate ligament, to the lateral border of the plantar surface of the bone. If the trochlear process is well developed it separates the tendons and tendon sheaths of the two peronaei. While the sheath of the Peronaeus brevis tendon ends a little beyond the process that of the longus extends into the sole of the foot, where it receives a new retinaculum, formed by the anterior part of the long plantar ligament.

At the medial malleolus the retinaculum for the flexor muscles, the Tibialis posterior, Flexor digitorum longus and Flexor hallucis longus, is formed by the broad *laciniate ligament,* which is indistinctly separated from the crural fascia.

On the dorsum of the foot the *cruciate ligament* is a forked strengthening of the dorsal fascia of the foot, which forms the retinaculum for the extensor tendons. It consists of a usually strong transverse portion (see Fig. 317), which passes from the medial malleolus to above the trochlear process of the calcaneus, and a band, at right angles to the transverse one, extending from the dorsal surface of the navicular to the anterior part of the calcaneus. The ligament contains three compartments for the tendons of the Tibialis anticus, the Extensor hallucis longus and the Extensor digitorum longus plus the Peronaeus tertius.

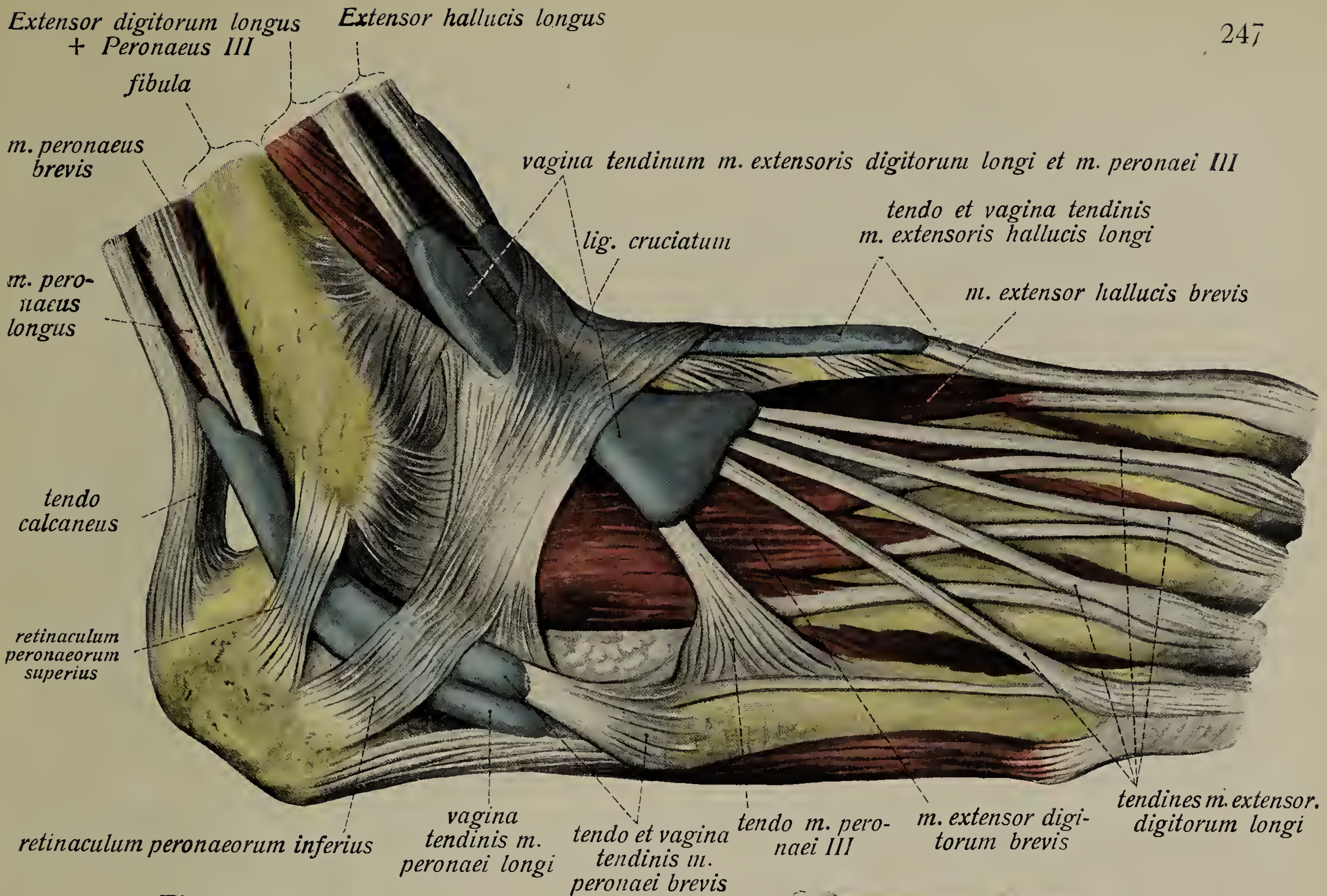
Extensor digitorum longus
+ Peronaeus III
Extensor hallucis longus
fibula
m. peronaeus brevis
vagina tendinum m. extensoris digitorum longi et m. peronaei III
tendo et vagina tendinis m. extensoris hallucis longi
lig. cruciatum
m. peronaeus longus
m. extensor hallucis brevis
tendo calcaneus
retinaculum peronaeorum superius
retinaculum peronaeorum inferius
vagina tendinis m. peronaei longi
tendo et vagina tendinis m. peronaei brevis
tendo m. peronaei III
m. extensor digitorum brevis
tendines m. extensor. digitorum longi

Fig. 323.

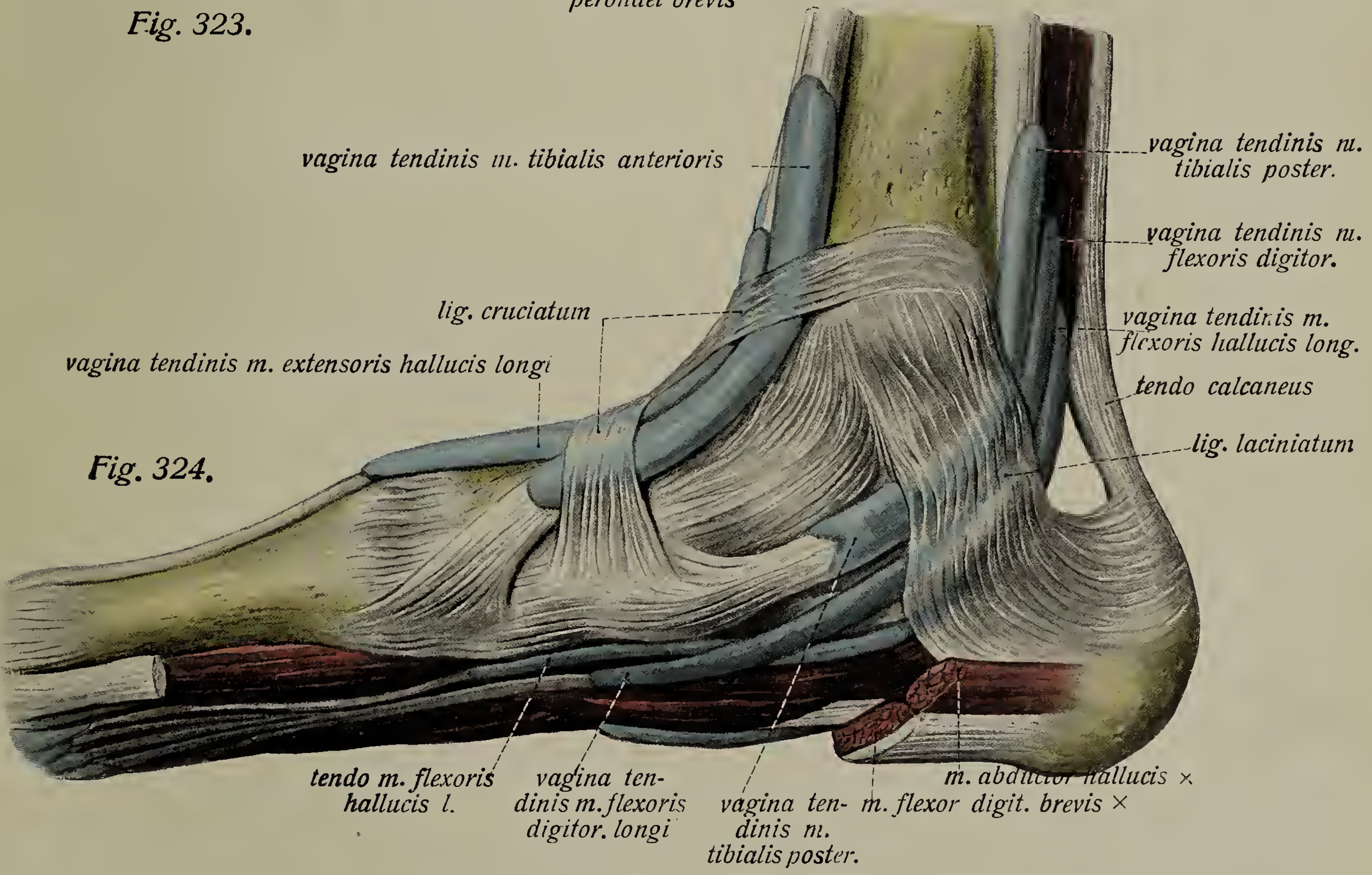
vagina tendinis m. tibialis anterioris
vagina tendinis m. tibialis poster.
vagina tendinis m. flexoris digitor.
lig. cruciatum
vagina tendinis m. flexoris hallucis long.
vagina tendinis m. extensoris hallucis longi
tendo calcaneus
lig. laciniatum
tendo m. flexoris hallucis l.
vagina tendinis m. flexoris digitor. longi
vagina tendinis m. tibialis poster.
m. abductor hallucis ×
m. flexor digit. brevis ×

Fig. 324.

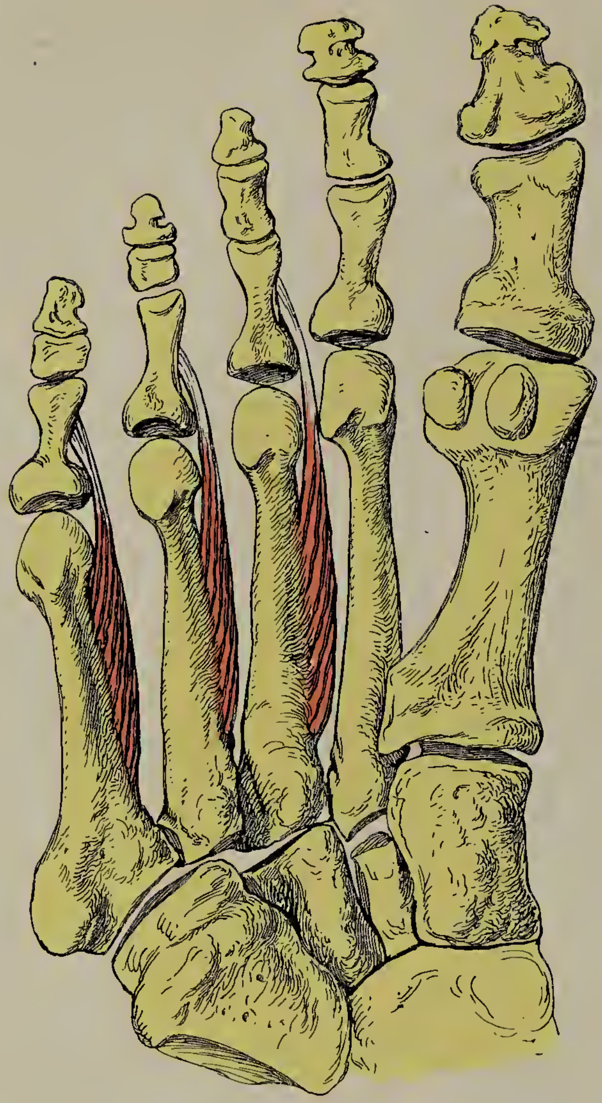

Fig. 325.

Schema of the plantar interossei.

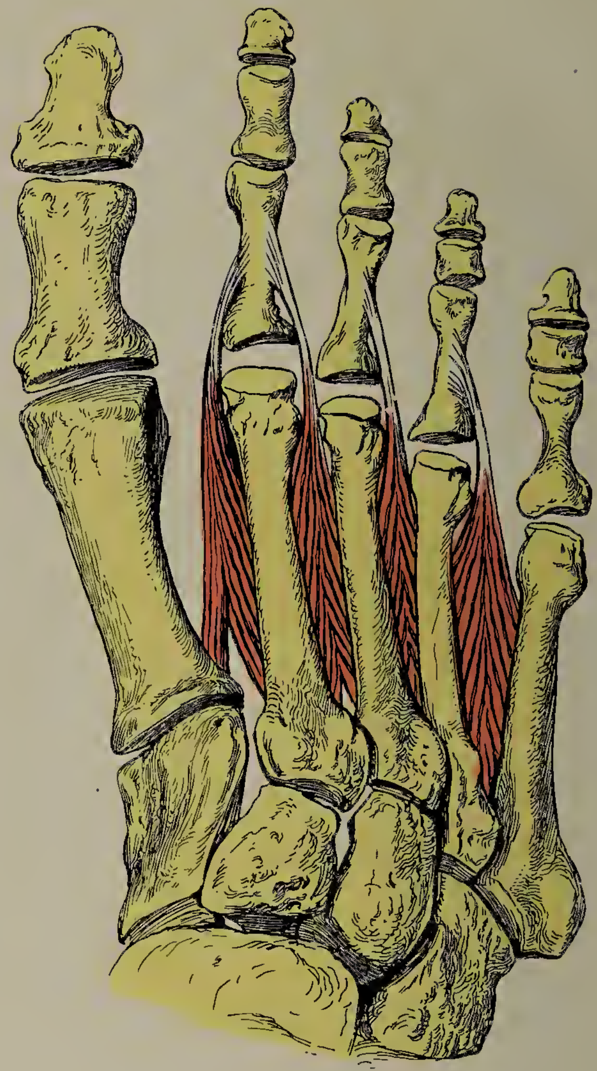

Fig. 326.

Schema of the dorsal interossei.

Fascia of the lower extremity.

Plate 3.

Fig. 1. Fascia of the thigh from in front. (1/4)
Fig. 2. Fascia of the thigh from behind. (1/4)

Plate 4.

Fig. 1. Fascia of the lower leg from behind. (1/4)
Fig. 2. Fascia of the lower leg and the dorsal fascia of the foot from in front. (1/4)

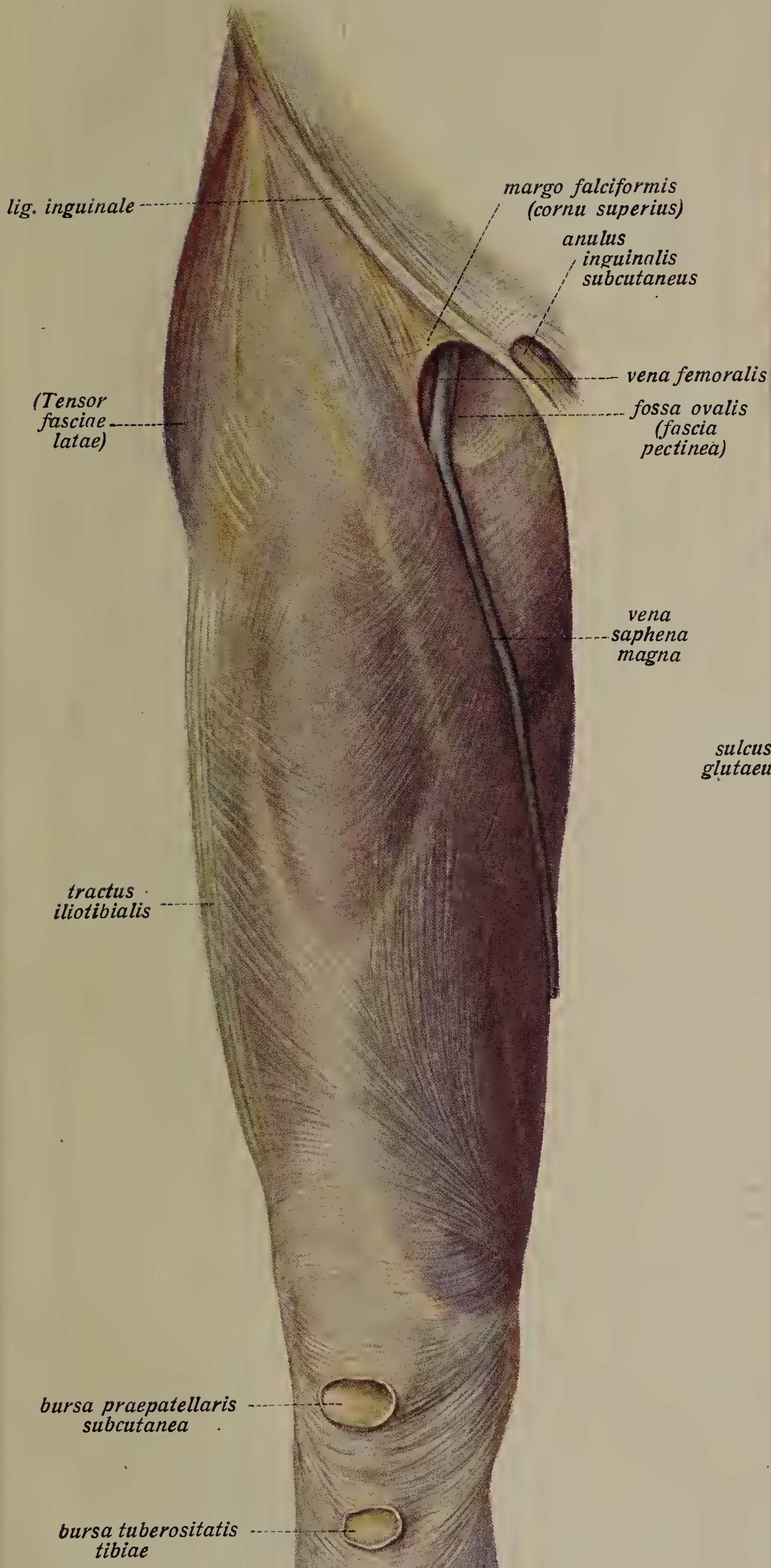
margo falciformis (cornu superius)
lig. inguinale
anulus inguinalis subcutaneus
vena femoralis
(Tensor fasciae latae)
fossa ovalis (fascia pectinea)
vena saphena magna
tractus iliotibialis
bursa praepatellaris subcutanea
bursa tuberositatis tibiae

Fig. 1.

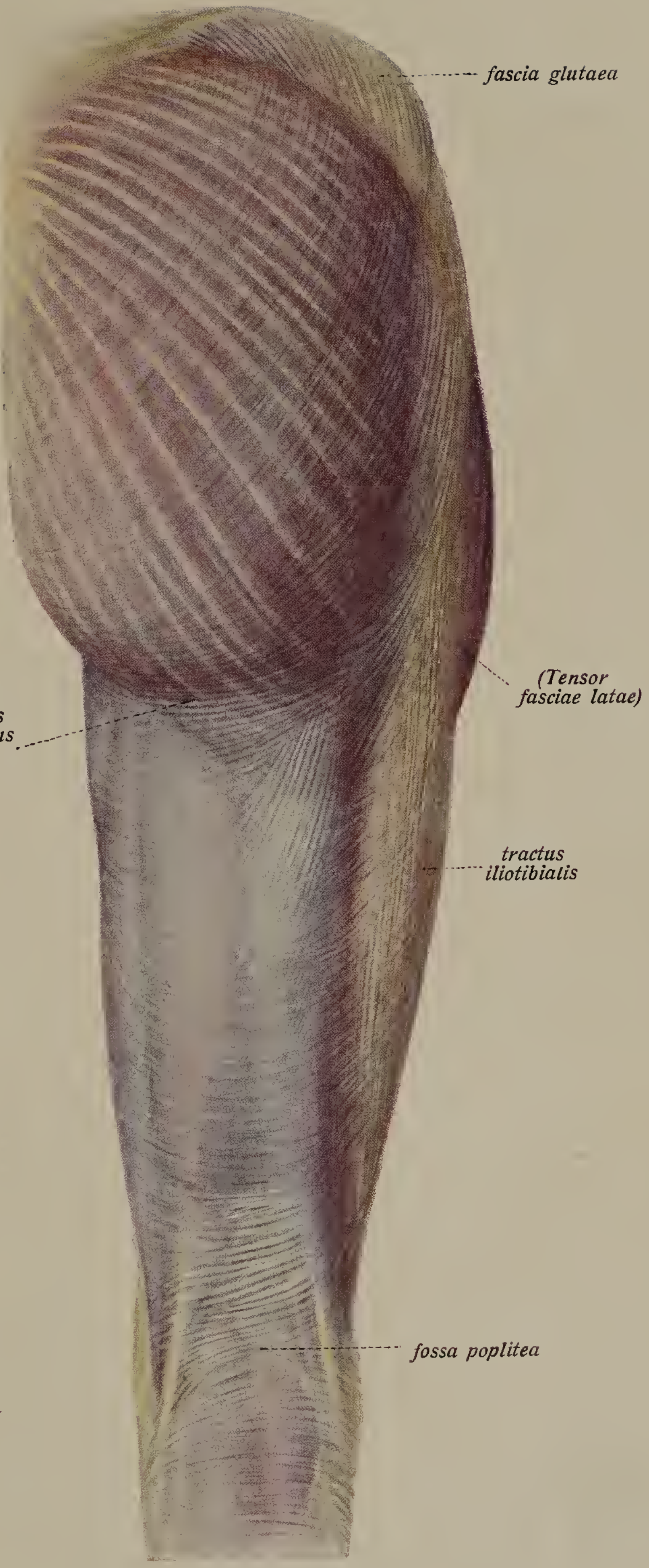
fascia glutaea
(Tensor fasciae latae)
sulcus glutaeus
tractus iliotibialis
fossa poplitea

Fig. 2.

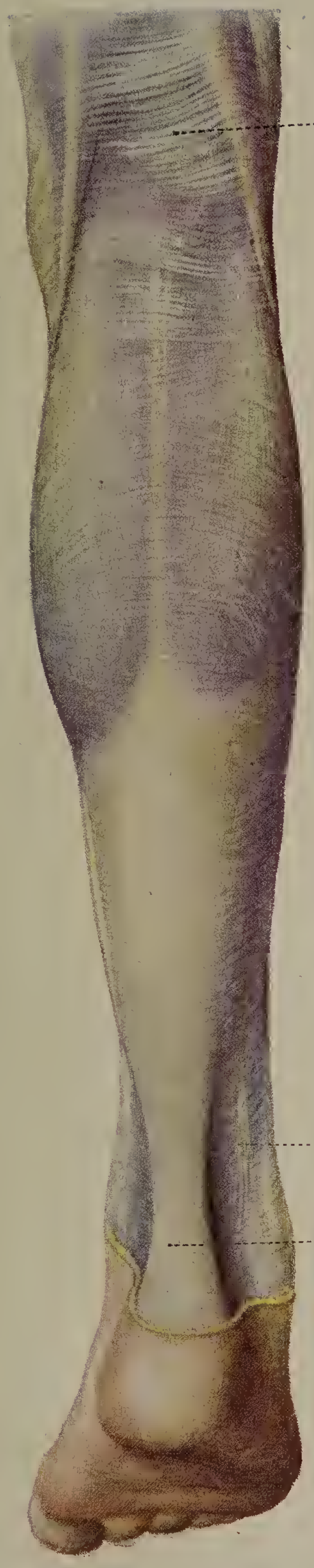
fossa poplitea
septum intermusculare posterius
(tendo calcaneus)

Fig. 1.

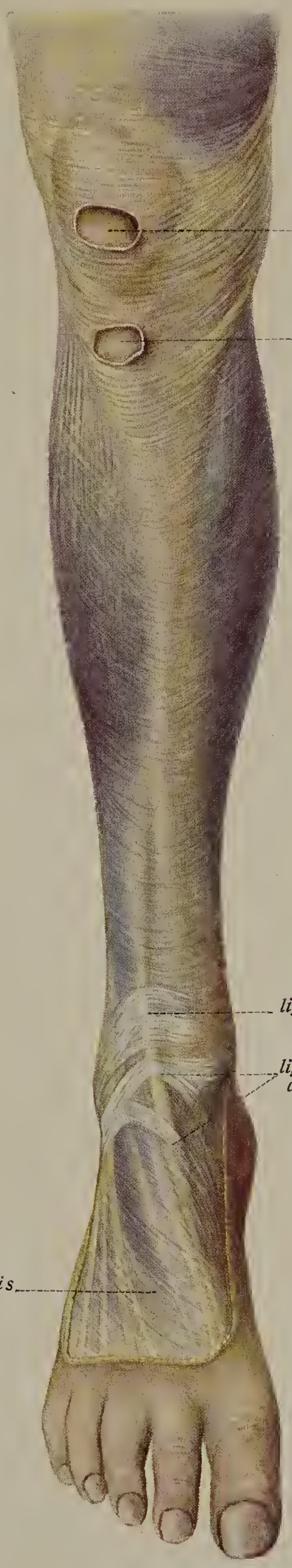
bursa praepatellaris subcutanea
bursa tuberositatis tibiae subcutanea
lig. transversum cruris
ligamentum cruciatum
fascia dorsalis pedis

Fig. 2.

INDEX

of the parts shown in the illustrations.

The numbers refer to the Figures, not to the pages. Numbers in ( ) signifies that the part in question appears in the picture without its name being specially given.

A.

acetabulum (ossis coxae) 136
acromion scapulae 35, 36, 109—112, 196, 199, 239
ala magna ossis sphenoidalis 40, 41, 44, 46, 49, 54—56, 97, 99—101
— ossis ilium 134, 136, 138
— parva ossis sphenoidalis 46, 49, 55, 56, 99
— vomeris 44, 75—77
alveoli dentales 99
angulus costae 28—30
— frontalis ossis parietalis 66, 67
— inferior scapulae 110, 118, 239
— lateralis scapulae 110—112
— mandibulae 92—98
— mastoideus ossis parietalis 66, 67
— medialis scapulae 110, 111
— occipitalis ossis parietalis 66, 67
— parietalis ossis sphenoidalis 53, 55
— pubis 212
— sphenoidalis ossis parietalis 44, 66, 67
— sterni 34
antrum mastoideum 65
— tympanicum 63, 64
anulus femoralis subcutaneus Tab. 3, Fig. 1
— fibrosus fibrocartilaginis intervertebralis 176, 178
— inguinalis subcutaneus = externus 248, 250, 251, Tab. 3, Fig. 1
— tympanicus 106
aorta 256
apertura externa aquaeductus vestibuli 58
— — canaliculi cochleae 60
— piriformis 81
— sinus frontalis 69, 104
— maxillaris 83, 104
— — sphenoidalis 55, 74, 104
— superior canaliculi tympanici 46, 59
apex capituli fibulae 150, 152
— ossis sacri 15, 16, 19
apex patellae 144, 145
— pyramidis 58—60
aponeurosis palmaris 286
— plantaris 319, 320
aponeuroses tendinum digitales dorsales manus 287
— — — — pedis 317
arcus anterior atlantis 6, 187
— lumbocostalis lateralis 256
— — medialis 256
— posterior atlantis 6, 187, 188
— superciliaris 68, 70
— vertebrae 1, 2, 4, 6, 8, 12, 14, 175—180
— zygomaticus 41, 44, 105, 192
arteria brachialis 204
— carotis communis 261
— — externa 259
— subclavia 262, 263
articulatio acromioclavicularis 196, 197, 199
— atlantoepistrophica 187—189
— atlantooccipitalis 188, 189
— calcaneocuboidea 228
— carpometacarpea (communis) 205
— — pollicis 205, 207
— capituli costae 177, 181, 183
— costotransversaria 181—183
— coxae 215—219
— cubiti 201—204
— cuneonavicularis 228
— genu 220—225
— humeri 196—200
— intercarpea 205
— mandibulae 192—194
— radiocarpea 205
— radioulnaris distalis 203, 205
— sacroiliaca (211—214), 218
— sternoclavicularis 195
— talocalcanea 228, 229
— talocruralis 229

articulatio talo- (calcaneo-) navicularis 229
— tarsi transversa 228
— tarsometatarsea (communis) 228
— — hallucis 228
— tibiofibularis 226
articulationes digitorum (manus) 208
— metacarpophalangeae 233
— metatarsophalangeae 206
— sternocostales 184
atlas 3, 5, 6, 185—188, 190, 191

B.

basis mandibulae 93
— ossis metacarpalis 128, 130
— — metatarsalis 155
— — sacri 16, 17, 19
— patellae 144, 145
— phalang. digitorum 132
bursa anserina 306
— bicipitoradialis 279
— glutaeofemoralis 300
— iliopectinea 305, 306
— infrapatellaris profunda 200, 224, 255
— — subcutanea Tab. 3, Fig. 1, Tab. 4, Fig. 2
— m. gastrocnemii medialis 312—314
— m. glutaei medii (anterior) 308
— m. latissimi 276
— m. obturatoris interni 308
— m. poplitei 314
— m. sartorii propria 306
— m. semimembranosi 312—314
— m. subscapularis 273
— praepatellaris subcutanea 225, Tab. 3, Fig. 1 Tab. 4, Fig. 2
— subcutanea olecrani 204, Tab. 2, Fig. 2
— subdeltoidea 272, 275
— suprapatellaris 220, 222, 225
— trochanterica m. glutaei maximi 300, 307, 308

C.

calcaneus 155—157, 160—162, 227—230
canaliculus caroticotympanicus 60
canaliculus chordae tympani 63
— mastoideus 63
canalis adductorius 304
— caroticus 60, 63—65
— carpi 288—290
— condyloideus 50, 51
— facialis 63
— femoralis 301
canalis hypoglossi 44, 46, 50—53, 188
— incisivus 75, 78, 103, 104
— infraorbitalis 99, 100
— inguinalis 252
— musculotubarius 59, 60, 65
— nasolacrimalis 81, 101
— obturatorius 219, 302, 306
— popliteus 312
— pterygoideus 55, 56, 99
— pterygopalatinus 99
— radialis 275
— sacralis 15, 17—19, 218
— semicircularis superior 63, 64
— — lateralis 63, 64
capitulum costae 26, 28—31, 177
— fibulae 149, 150, 152, 220
— humeri 116—118
— ossis metacarpalis 128, 131
— — metatarsalis 156
— radii 123, 125, 126
— processus condyloidei mandibulae 93
— ulnae 119
caput femoris 139—142, 218, 219
— humeri 115—117
— tali 155, 156, 158, 159
carpus 128—133
cartilago thryreoidea 261, 262
— cricoidea 261
cavitas glenoidalis scapulae 36, 110—112, 199, 200
cellulae ethmoidales 72, 73, 100, 101
— mastoideae 63—65
centrum tendineum (diaphragmatis) 256
choana 108
chorda obliqua 201, 203
circumferentia articularis radii 124, 126, 203
— — ulnae 121, 128
clavicula 35—38, 113, 114, 195, 196
clivus (Blumenbachii) 46, 49
cochlea 64
collum anatomicum humeri 116, 117
— chirurgicum humeri 115
— costae 27—30
— femoris 139—142, 216
— mandibulae 94
— radii 123, 126
— scapulae 110, 111
— tali 159
columna vertebralis 23—25
concha nasalis inferior 40, 83, 84, 100, 103
— — media 73, 100, 103, 104
— — superior 103
— sphenoidalis 55, 74

condylus lateralis femoris 139, 140, 143, 222, 223
— — tibiae 146, 147
— medialis femoris 139, 140, 143, 222, 223
— — tibiae 146, 147
— occipitalis 44, 50—52
cornu coccygeum 20, 22
— majus ossis hyoidei 96, 260
— minus ossis hyoidei 96, 260
— sacrale 15, 20
corpus adiposum buccae 264, 268
— calcanei 162
— claviculae 114
— costae 29—31
— epistrophei 7, 8, 187—189
— femoris 139—141
— fibulae 149
— humeri 115
— mandibulae 40, 92, 93
— maxillae 78, 196, 197
— ossis hyoidei 96, 259
— — ilium 134, 137, 138
— — ischii 136—138
— — pubis 136—138
— — sphenoidalis 46, 54—56, 75, 98, 103
— sterni 33, 34, 38
— tibiae 147
— vertebrae 1, 2, 3a, 4, 7, 8, 12, 14, 177, 181
costae 26—32, 35—38
— spuriae 31, 32
— verae 26—30
cranium 39 ff.
crista anterior fibulae 149, 150, 154
— — tibiae 146, 154
— buccinatoria mandibulae 92, 95
— capituli costae 29
— colli costae 28, 29
— conchalis maxillae 78
— — ossis palatini 87
— ethmoidalis maxillae 78, 103
— — ossis palatini 82, 87, 104
— frontalis (ossis frontalis) 46, 69
— galli 46, 72—75, 100, 103
— iliaca 134—138, 239
— infratemporalis ossis sphenoidalis 44, 55
— interossea fibulae 149, 154
— — radii 122—125
— — tibiae 147, 148, 154
— — ulnae 119, 121, 122
— intertrochanterica (femoris) 142
— lacrimalis anterior 79, 97, 98
— — posterior 80, 97, 98
— lateralis fibulae 150, 154
crista m. supinatoris (ulnae) 119
— nasalis 81
— obturatoria 134
— occipitalis externa 50
— — interna 40
— orbitalis ossis sphenoidalis 54, 55
— posterior fibulae 149, 154
— sacralis articularis 15, 17
— — lateralis 15
— — media 15, 18, 20, 210
— sphenoidalis 55, 75
— tuberculi majoris humeri 116
— — minoris humeri 116
crus inferius anuli inguinalis externi 250, 251
— superius anuli inguinalis externi 250, 251
— — — femoralis Tab. 3, Fig. 1

D.

dens epistrophei 3, 7, 8, 187, 189, 190
discus articularis artic. mandibulae 194, 270
— — — radiocarpeae 205
— — — sternoclavicularis 195
dorsum sellae turcicae 46, 56
ductus parotideus 265, 268, 270
dura mater 187

E.

eminentia arcuata ossis temporalis 58, 59, 65
— iliopectinea 136—138
— intercondyloidea tibiae 147, 148
— plantaris intermedia 319
— — lateralis 319
— — medialis 319
epicondylus lateralis femoris 139, 141, 143
— — humeri 115, 116, 118, 201, 202
— medialis femoris 139—141, 143
— — humeri 115, 116, 118, 202
epigastrium 235
epistropheus 7, 8, 185—191
extremitas acromialis claviculae 114
— inferior s. superior humeri, ulnae etc. vide the corresponding bones.
— sternalis claviculae 114

F.

facies anterior medialis humeri 116
— — lateralis humeri 116
— — pyramidis 46, 59
— articularis acromialis claviculae 113
— — acromii scapulae 111

facies articularis anterior calcanei 160—162, 232
— — — dentis epistrophei 7, 187, 190
— — calcanea anterior (tali) 158
— — — media (tali) 158
— — — posterior (tali) 158
— — capituli costae 28, 29
— — — fibulae 149
— — carpea radii 124, 127, 203
— — cuboidea calcanei 160—162
— — fibularis tibiae 148
— — inferior tibiae 146—148, 229
— — — vertebrae 6, 7, 13
— — malleolaris tibiae 147, 148, 153, 229
— — malleoli lateralis 149, 153
— — media calcanei 160—162
— — navicularis tali 158, 159
— — patellae 145
— — posterior calcanei 160—162, 232
— — — dentis epistrophei 187, 190
— — superior vertebrae 4, 5, 7—9, 12, 13, 183
— — sternalis claviculae 113
— — tuberculi costae 29, 30
— auricularis ossis ilium 135, 137
— — ossis sacri 15, 20
— cerebralis alae magnae ossis sphenoidalis 46, 56
— — partis orbitalis ossis frontalis 69
— — squamae frontalis 69, 99
— — temporalis 58, 59
— costalis scapulae 111, 112
— dorsalis ossis sacri 15, 239
— — radii 122, 124, 125
— — scapulae 110, 112
— — ulnae 119—122
— frontalis squamae frontalis 68
— infratemporalis alae magnae ossis sphenoidalis 44, 54, 55
— infraorbitalis maxillae 79
— lateralis fibulae 150, 154
— — radii 122, 125
— — tibiae 146—148, 154
— lunata acetabuli 134, 136, 217
— malaris ossis zygomatici 90
— maxillaris ossis palatini 86
— medialis fibulae 149, 154
— — tibiae 146, 154
— — ulnae 120, 122
— nasalis corporis maxillae 78, 82
— orbitalis alae magnae ossis sphenoidalis 54, 55, 97
— — maxillae 79
— — ossis frontalis 40, 68, 70
facies orbitalis ossis zygomatici 90, 91
— — partis orbitalis ossis frontalis 40, 68, 70
— patellaris femoris 141, 143, 222, 223
— pelvina ossis sacri 16, 19
— posterior fibulae 149, 154
— — humeri 115
— — tibiae 147, 148, 154
— symphyseos ossis pubis 135, 137, 219
— sphenomaxillaris alae magnae ossis sphenoidalis 54, 55
— temporalis alae magnae ossis sphenoidalis 40, 54
— — ossis frontalis 68
— — — zygomatici 44, 91
— — squamae frontalis 57
— — — temporalis 57
— volaris radii 122—124
— — ulnae 121, 122
fascia antebrachii 274—278, 282
— axillaris Tab. 2, Fig. 1
— brachii 255, 273
— colli 258
— coracoclavicularis 249
— cruris 311, 315, 316
— — lamina profunda 311, 313, 314
— dorsalis pedis Tab. 4, Fig. 2
— glutaea Tab. 3, Fig. 2, 299, 300, 307, 310
— ileopectinea 301
— iliaca 301
— infraspinata 239—241, 274
— lata 299, 301, 303—305, 310
— lumbodorsalis 239—243, 247, 256, 299, 300
— parotideomasseterica 264
— pectinea Tab. 3, Fig. 1, 301
— pectoralis 258
— temporalis 264, 268
— transversalis 243, 254
— volaris manus = thenatis 286
fasciculi transversi 286
femur 139—143
fenestra vestibuli 61
fibrae anulares ligamenti vaginalis digiti 288
— cruciatae ligamenti vaginalis digiti 288
— intercrurales 250, 251
fibrocartilago navicularis 232
— interpubica 211, 218
— intervertebralis 175—178, 180, 183, 186
fibula 149—153, 221, 223, 226, 227, 229, 231
fissura orbitalis inferior 40, 97, 100, 101
— — superior 40, 46, 97, 100
— petrooccipitalis 44, 46
— petrosquamosa 46, 59

fissura petrotympanica 57, 60
— pterygoidea 55
— pterygomaxillaris 105
— sphenopetrosa 44, 46
— tympanomastoidea 57
fonticulus frontalis 106, 107
— mastoideus 106, 108
— occipitalis 106—108
— sphenoidalis 106
foramen alveolare 79, 105
— caecum 46, 69
— caroticum exterum 44, 60
— — interum 59, 60, 65
— condyloideum 46
— ethmoidale anterius 70, 97, 98
— — posterius 70, 97, 98
— incisivum 44, 81, 102
— infraorbitale 40, 79, 97
— intervertebrale 25, 176, 177
— — ossis sacri 18
— ischiadicum majus 210, 213, 300
— — minus 210, 213
— jugulare 46
— lacerum 44, 46
— mandibulare 94, 95
— mastoideum 44, 46, 57—60
— mentale 40, 41, 92, 93
— nasale 88, 89
— nutricium, vide the corresponding bones
— obturatum 135
— occipitale magnum 43—46, 50, (51), 52, 53
— opticum 46, 53, 97, 98
— ovale 44, 46, 105, 153
— palatinum majus 86, 87, 102
— palatinum minus 102
— parietale 66, 67
— rotundum 46, 55, 56, 98, 99
— sacrale anterius 16, 18
— — posterius 15, 18
— sphenopalatinum 98, 103, 104
— spinosum 44, 46, 53
— stylomastoideum 44, 63
— supraorbitale 68
— transversarium (vertebrae cervicalis) 4—6, 8
— venae cavae 256
— vertebrale 1, 4—6, 9, 12, 14, 181
— zygomaticofaciale 90, 97, 105
— zygomaticoorbitale 90, 91, 99
— zygomaticotemporale 91
fossa acetabuli 134, 217
— axillaris 235, 248
— canina 79
fossa carotica 237
— condyloidea 44, 50
— coronoidea 116, 204
— cranii anterior 46
— — media 46
— — posterior 46
— digastrica 94, 95
— glandulae lacrimalis 71
— hypophyseos 46
— iliaca 135, 136
— infraspinata 109
— infratemporalis 105
— intercondyloidea (femoris) 139, 143
— — anterior (tibiae) 152
— — posterior (tibiae) 152
— jugularis 237
— — ossis temporalis 44, 60
— mandibularis 44, 57, 60
— occipitalis inferior 46, 51
— — superior 51
— olecrani 115, 204
— ovalis 301 Tab. 3, Fig. 1
— poplitea 235, Tab. 3, Fig. 1, Tab. 4, Fig. 1
— pterygoidea 56
— pterygopalatina 98, 99, 105
— radialis 116
— retromandibularis 237
— sacci lacrimalis 80, 98, 101
— scaphoidea 56
— subarcuata 46, 58, 59
— subscapularis 111
— supraclavicularis major 237
— — minor 237
— supraspinata 109
— suprasternalis 237
— temporalis 41
— trochanterica 140
fossula petrosa 60
fovea articularis inferior atlantis 6
— — superior atlantis 5
— capitis femoris 140—142
— capituli radii 126
— costalis inferior 2, 10, 13
— — superior 2, 10—12, 183
— costalis transversalis 2, 11, 12, 179, 183
— dentis (atlantis) 6, 190
— nuchae 236
— pterygoidea (mandibulae) 93
— sublingualis (mandibulae) 94, 95
— submaxillaris (mandibulae) 94, 95
— trochlearis (ossis frontalis) 70
foveolae ethmoidales (ossis frontalis) 70

foveola radialis 287
funiculus spermaticus 248, 250, 252, 253

G.

galea aponeurotica 264, 265, 268, 269
glabella 68, 70
glandulae buccales 270
glandula parotis 259, 261, 265
— submaxillaris 259, 261
— thyreoidea 261, 262

H.

hamulus lacrimalis 80
— ossis hamati 131
— pterygoideus 55, 56, 98, 99, 103—105, 211
hiatus adductorius 305
— aorticus 256
— canalis facialis 46, 59
— (canalis) sacralis 15
— oesophageus 256
— semilunaris 103
— sinus maxillaris 78
humerus 37, 115—118, 201, 204
hypothenar 286

I.

impressiones digitatae 46
incisura acetabuli 134
— clavicularis manubrii sterni 33, 34
incisurae costales sterni 33, 34
incisura ethmoidalis ossis frontalis 70
— fibularis tibiae 146, 148
— frontalis ossis frontalis 68
— incisiva 78
— ischiadica major 134, 135
— — minor 134, 135
— jugularis manubrii sterni 33
— — ossis occipitalis 52, 53
— — — temporalis 58, 60
— lacrimalis maxillae 78, 79
— mandibulae 93, 95
— mastoidea ossis temporalis 44, 57, 60
— nasalis maxillae 79
— parietalis ossis temporalis 57—59
— radialis ulnae 119, 121
— scapulae 110, 111
— semilunaris ulnae 119, 121, 126, 203
— sphenopalatina (ossis palatini) 82, 86, 87
— supraorbitalis ossis frontalis 68—71, 97
— ulnaris radii 124
incisura vertebralis inferior 2, 10, 176
— superior 2, 10, 17
— — — ossi sacri 17
inscriptiones tendineae m. recti abdom. 248, 252, 253

J.

juga alveolaria maxillae 70
— — mandibulae 92
— cerebralia 47
juncturae tendinum (digitalium dorsalium) 287, 296

L.

labium laterale cristae iliacae 134, 136
— — lineae asperae femoris 139, 142
— mediale cristae iliacae 134, 136
— — lineae asperae femoris 139, 142
labrum glenoidale (articulationis coxae) 217, 219
— — scapulae 199
labyrinthus ethmoidalis 72, 104
lacertus fibrosus 276—278, Tab. 2, Fig. 1
lacuna musculorum 301
lacuna vasorum 256, 301
lamina cribrosa (ossis ethmoidalis) 46, 71, 72, 75, 103, 104
— lateralis processus pterygoidei 44, 55, 56, 81, 98, 102
— medialis processus pterygoidei 44, 55, 56, 81, 102, 103, 108, 271
— papyracea (ossis ethmoidalis) 72, 73, 97, 101
— perpendicularis (ossis ethmoidalis) 71—73, 75, 100
ligamentum accessorium plantare 234
— — volare 207, 290
— acromioclaviculare 197, 199, 272
— alare 188, 189
— anulare radii 201—203, 285
— apicis dentis 189
— arcuatum pubis 209—211, 218
ligamentum (-a) basium (ossium metacarpalium) dorsalia 206
— — — — volaria 207
— — (ossium metatarsalium) dorsalia 231
— — — — interossea 228
— — — — plantaria 233
— bifurcatum 231
— calcaneocuboideum dorsale 231, 232
— calcaneofibulare 227, 229, 231, 234
— calcaneonaviculare plantare 230, 233, 234
— calcaneotibiale 227, 230, 234

ligamentum (-a) capituli costae interarticulare 177
— — — radiatum Tab. 1, Fig. 2, 174, 181, 183
— fibulae 221, 223, 226
— (-a) capitulorum (ossium metacarpalium) transversa 207, 288
— capitulorum (ossium metatarsalium) transversa 231, 233, 234
ligamentum carpi dorsale 278, 282—285, 287, 296, Tab. 2, Fig. 2
— — radiatum 207
— — transversum 288—291, 295
— — volare 286, Tab. 2, Fig. 1
— (-a) carpometacarpeum (-ea) dorsale (-ia) 206
— — — — volaria 206
— collaterale carpi radiale 205, 206
— — — ulnare 206, 207
— (-a) — (-ia) digitorum manus 206, 208
— — fibulare 220—222
— collaterale (cubiti) radiale 201, 202
— — — ulnare 201
— — tibiale 220, 221
— colli costae 179, 181
— coracoacromiale 196, 197, 199
— coracoclaviculare 196, 199
— coracohumerale 198, 200
— costoclaviculare 195
— costotransversarium anterius 174, 177, 182, 183
— — posterius 177, 182, 246, 247
— (-a) costoxiphoideum (-a) 248
— cruciatum atlantis 188
— — cruris 315—318, 323, 324, Tab. 4, Fig. 2
— — (genu) anterius 223, 224
— — — posterius 223, 224
— cuboideonaviculare dorsale 231
— — plantare 233
— cuneocuboideum dorsale 232
— cuneometatarseum interosseum 228
— deltoideum 229, 230
— flavum 176, 179, 181, 182
— fundiforme penis 248, 250
— hamatometacarpeum 207
— iliofemorale 211, 213, 215—217
— iliolumbale 209, 211, 213, 257
— inguinale 210, 211, 213, 249, 250—252, 256, 301
— — reflexum 251
— interclaviculare 195
— intercostale externum Tab. 1
— — internum Tab. 1, Fig. 2
— (-a) intercuneiforme (-ia) dorsalia 232
— — interosseum 228
ligamentum intercostale plantaria 234
— (-a) interspinale (-ia) 176, 246
— intertransversarium 182, 183, 246, 247
— ischiocapsulare 216, 219
— laciniatum 312—314, 322, 324
— lacunare 214, 256, 301
— longitudinale anterius 174, 183, 186, 211, 213, Tab. 1, Fig. 2
— longitudinale posterius 175, 180
— lumbocostale 257
— malleoli lateralis anterius 226, 231
— — — posterius 227
— (-a) navicularicuneiformia dorsalia 231, 232
— — plantaria 233, 234
— nuchae 241, 245
— palpebrale mediale 265, 266
— patellae 220, 224, 225, 303—305, 315, 316
— pisohamatum 207
— pisometacarpeum 207
— plantare longum 229—231, 233, 234, 322
— popliteum arcuatum 221, 312
— — obliquum 221, 312, 313
— pubicum superius 211, 213
— pubocapsulare 215, 219
— radiocarpeum dorsale 206
— — volare 207
— sacrococcygeum anterius 213, 218
— — laterale 213, 218
— — posterius 209, 210
— sacroiliacum anterius 222, 213, 218
— — interosseum 218
— — posterius breve 209, 218
— — — longum 209
— sacrospinosum 209, 210, 218
— sacrotuberosum 209, 210, 216, 218
— sphenomandibulare 193
— sternoclaviculare 195
— sternocostale intraarticulare 184
— — radiatum 195
— stylomandibulare 192, 193
— supraspinale 182, 209, 244
— talocalcaneum anterius 231
— — interosseum 228, 232
— — laterale 231
— — mediale 227
— — posterius 227
— talofibulare anterius 231
— — posterius 227
— talotibiale anterius 230
— — posterius 227, 230
— (-a) tarsometatarseum (-a) dorsale (-ia) 230—282

ligamentum talotibiale plantaria 233, 234
— temporomandibulare 192
— teres (coxae) 217—219
— tibionaviculare 230
— transversum acetabuli 217
— — atlantis 187, 190
— — cruris Tab. 4, Fig. 2
— — genu 223, 224
— — scapulae inferius 198
— transversum scapulae superius 196, 198
— tuberculi costae 181, 182
ligamenta vaginalia digitorum manus 288, 289, 291
— — — pedis 320
limbus alveolaris mandibulae 82, 93
linea alba 248, 250, 251, 254
— arcuata 135
— aspera femoris 139, 140, 142
— glutaea anterior 134
— — inferior 134
— — posterior 134
— intercondyloidea (femoris) 139
— intermedia cristae iliacae 134, 136
— intertrochanterica (femoris) 141
lineae musculares scapulae 111
linea mylohyoidea 94, 95
— nuchae inferior 44, 50, 52
— — superior 44, 50
— — suprema 50
— obliqua mandibulae 92, 93
— pectinea 139, 142
— poplitea tibiae 147
— semicircularis (Douglasi) 253
— semilunaris (Spiegeli) 253
— temporalis superior 41, 47, 66, 68
— — inferior 41, 57, 66
— terminalis 17, 213
lineae transversae ossis sacri 16
lingula mandibulae 94, 95
— sphenoidalis 46, 53, 56

M.

malleolus lateralis 149, 150, 153, 226, 229
— medialis 146, 153
mandibula 40, 41, 92—95, 106
manubrium sterni 33, 34, 38, 195
margo axillaris scapulae 110—112
— dorsalis radii 122, 125
— — ulnae 120, 122
— falciformis fasciae latae Tab. 3, Fig. 1, 301
— frontalis ossis parietalis 66, 67
margo frontalis ossis sphenoidalis 53, 55
— infraglenoidalis tibiae 146
— infraorbitalis 40, 79, 90
— — ossis zygomatici 90
— lacrimalis maxillae 78, 79
— lambdoideus ossis occipitalis 50, 51, 53
— lateralis humeri 116
— mastoideus ossis occipitalis 51, 53
— — ossis sphenoidalis 53
— medialis humeri 116
— medialis tibiae 147
— occipitalis ossis parietalis 66, 67
— — — temporalis 57, 58, 60
— parietalis ossis frontalis 68, 69
— — — temporalis 57, 58
— sagittalis ossis parietalis 66, 67
— sphenoidalis ossis temporalis 57, 80, 60
— squamosus ossis parietalis 66, 67
— — ossis sphenoidalis 53, 56
— superior scapulae 110, 111
— supraorbitalis 40, 68, 70
— vertebralis scapulae 110, 111
— volaris radii 122, 123
— — ulnae 122
— zygomaticus ossis sphenoidalis 55
massa lateralis atlantis 5, 6
maxilla 40, 41, 44, 78, 79
meatus acusticus externus 57, 64, 65, 192
— — internus 63, 64
— nasi inferior 100, 103
— — medius 103
— — superior 163
membrana atlantooccipitalis anterior 186
— — posterior 185
— interossea antibrachii 203, 206, 285
— — cruris 226
— obturatoria 211, 215, 218, 219
— tectoria 187, 191
— tympani 108
meniscus lateralis (artic. genu) 223—225
— medialis (artic. genu) 223, 224
metacarpus 128—133
metatarsus 155—157
musculus abductor digiti V (manus) 288—291, 295
— — — — (pedis) 320—322
— — hallucis 320—322, 324
— — pollicis brevis 288—291, 295
— — — longus 278, 280, 282—285, 288—290, 295, 296
— adductor brevis 305, 306
— — hallucis 321, 322
— — longus 302—306

musculus adductor magnus 221, 302, 303, 305—309
— — minimus 300, 306—308
— — pollicis 288—291, 295
— anconaeus 275, 282—285
— articularis genu 220
— auricularis anterior 264, 265
— — posterior 264
— — superior 264, 265
— biceps brachii 195, 199, 201, 203, 272—281, 583
— biceps femoris 225, 307—314, 316
— brachialis 272, 274—283
— brachioradialis 274—276, 278—284, 288
— buccinator 265, 267—270
— caninus 264, 265, 267, 269, 270
— coccygeus 227
— constrictor pharyngis inferior 262
— coracobrachialis 273, 276, 277
— corrugator supercilii 265, 266
— cremaster 252
— deltoideus 239—241, 248, 249, 255, 259, 261, 272—277
— depressor septi (nasi) 265—267
— diaphragma, Tab. 1, Fig. 1, 256
— digastricus 259, 261, 262
— epicranius auricularis vide auricularis anterior
— extensor carpi radialis brevis 274—276, 278, 279, 282—285, 287
— — — — longus 274—285, 287
— — — ulnaris 282—285, 287, 296
— — digitorum (manus) communis 282—285, 287, 294, 296, 297
— — digiti V (manus) proprius 282—284, 287, 296
— — digitorum (pedis) brevis 315—318, 323
— — — — longus 315—318, 323
— — hallucis brevis 315—318, 323
— — — longus 315—318, 223, 324
— — indicis proprius 285
— — pollicis brevis 282—285, 287, 298
— — — longus 283—285, 287, 296
— flexor carpi radialis 278—281, 288—291, 295
— — — ulnaris 278—285, 288, 289, 291, 295
— — dig. V (manus) brevis 288—291
— — — — (pedis) brevis 320—322
— — digitorum (pedis) brevis 320—322, 324
— — — — longus 312—314
— — — (manus) profundus 281, 288—291, 293—295
— — — — sublimis 278—281, 288—291, 293—295

musculus flexor hallucis brevis 320—322
— — — longus 312—314
— — pollicis brevis 288—291
— — — longus 278—281, 288, 290, 295
— frontalis 264—266, 268—270
— gastrocnemius 221, 225, 307—316
— gemellus inferior 300, 307, 308
— — superior 300, 307, 308
— genioglossus 260, 271
— geniohyoideus 255, 260, 262, 271, 302
— glutaeus maximus 299, 300, 302, 308, 310
— — medius 300, 304—308
— glutaeus minimus 307, 308
— gracilis 302—309, 311
— iliacus 256, 301, 304
— iliocostalis cervicis 241, 242, 244, 245
— — dorsi 241, 242
— — lumborum 241, 242
— iliopsoas 256, 302—305, 308
— incisivus labii inferioris 267
— — — superioris 217
— infraspinatus 167, 198, 272, 275
— (-i) intercostales externi 252, 253, Tab. 1, Fig. 1
— — interni 252, 253, Tab. 1, Fig. 2
— (-i) interossei dorsales manus 285, 287, 290, 291, 294, 296, 297
— — — pedis 317, 318, 326
— — plantares 320—322, 425
— — volares 290—292, 294, 297
— (-i) interspinales 244, 246
— (-i) intertransversarii 242, 246, 247
— latissimus dorsi 239—241, 243, 248, 249, 252, 253, 255, 259, 273, 274, 276, 277
— levator costae 242, 246, 247
— — scapulae 240, 241, 245, 255, 259, 262, 264, 272
— longissimus capitis 241, 242, 244, 245
— — cervicis 241, 242, 244, 245
— — dorsi 241, 242
— longus capitis 263
— — colli 263
— (-i) lumbricales manus 286, 288—290, 293—295, 287
— — pedis 320, 321
— masseter 265, 268, 269
— mentalis 264, 265, 267, 270
— multifidus 242, 246, 247
— mylohyoideus 259—262, 271
— nasalis 264—266, 268—270
— obliquus abdominis externus 239—243, 248—255

musculus obliquus abdominis internus 240, 241, 243, 252—255
— — capitis inferior 242, 244, 246
— — — superior 242, 244, 246
— obturator externus 306, 308
— — internus 300, 302—304, 307, 308
— occipitalis 264, 268, 269
— omohyoideus 255, 259, 261, 273, 276
— opponens digiti V manus 288—291, 295
— — — — pedis 322
— — pollicis 288—291, 295
— orbicularis oculi 264—266, 268—270
— — oris 264, 265, 267—270
— palmaris brevis 286
— — longus 278—281, 286
— pectineus 303—306
— pectoralis major 248, 249, 252, 253, 255, 259, 261, 272, 274, 276
— — minor 249, 255, 273, 276
— peronaeus brevis 312, 314—318, 323
— — longus 312, 313, 315, 316, 323
— — tertius 323
— piriformis 300, 302, 303, 305—398
— plantaris 300—314
— platysma 258, 259, 261, 264
— popliteus 221, 313, 314
— procerus 264—266, 269
— pronator quadratus 278—281, 289, 290
— — teres 279—281, 234, 285
— psoas major 243, 256, 301, 304
— — minor 256, 301
— pterygoideus externus 194, 270, 271
— — internus 270, 271
— pyramidalis 252, 253
— quadratus femoris 300, 307, 308
— — labii inferioris 264, 265, 267, 269
— — — superioris 264—266, 268, 269
— — lumborum 243, 256, 257
— — plantae 321, 322
— quadriceps femoris 220, 225, 303, 304, 316
— rectus abdominis 253—256
— — capitis anterior 263
— — — lateralis 263
— — — posterior major 242, 244, 246
— — — — minor 242, 244, 246
— — femoris 215—217, 219, 303—306
— rhomboideus major 239—242, 272
— — minor 240, 272
— risorius 264, 265
— (-i) rotatores breves 246, 247
— — longi 246
— sacrospinalis 242
musculus sartorius 302—306, 310
— scalenus anterior 255, 261—263
— — medius 245, 255, 259, 261—263
— — posterior 240, 241, 245, 255, 259, 261—263
— semimembranosus 221, 307—309, 311—314
— semispinalis capitis 241, 242, 244, 245
— — cervicis 242, 244
— — dorsi 242, 244, 245
— semitendinosus 306—309, 311
— serratus anterior 240—242, 248, 249, 252, 253, 255, 262, 273
— — posterior inferior 240, 241
— — — superior 240, 241
— soleus 311—316
— spinalis cervicis 242
— spinalis dorsi 241, 242
— spinotransversalis 241, 247
— splenius capitis 239—242, 244, 256, 262, 264, 288, 269
— — cervicis 240—242
— sternalis 249
— sternocleidomastoideus 239—241, 245, 248, 249, 255, 258, 259, 261, 262, 264, 268, 269
— sternohyoideus 255, 259, 261, 262, Tab. 1, Fig. 1
— sternothyreoideus 255, 261, 262, Tab. 1, Fig. 1
— stylohyoideus 255, 259, 261, 262
— subclavius 249, 273, 276
— (-i) subcostales Tab. 1, Fig. 2
— subscapularis 196, 255, 273, 276, 277
— supinator 279—281, 234, 285
— supraspinatus 197, 198, 272, 273, 275
— temporalis 259, 270
— tensor fasciae latae 303, 304, 307, 310
— teres major 239, 241, 272—277
— — minor 197, 198, 272, 275
— thyreohyoideus 255, 259, 261, 262
— tibialis anterior 315—318, 324
— — posterior 313, 314
— transversospinalis 242
— transversus abdominis 243, 253—256
— — thoracis Tab. 1, Fig. 1
— trapezius 239—242, 255, 259, 261, 262, 264, 268, 269, 272—274, 277
— triangularis 264, 265, 267—269
— triceps brachii 196—199, 204, 272, 274—279, 282—284
— — surae 311, 312
— vastus intermedius 305, 306
— — lateralis 303—306, 308—310
— — medialis 303—306, 309
— zygomaticus 264, 265, 268, 269

N.

nucleus pulposus (fibrocartilaginis intervertebralis) 176, 178

O.

oesophagus 256
olecranon 119, 120, 126, 202
os capitatum 128—131, 205—207
— coccygis 20—23, 37, 38
— coxae 134—138
— cuboideum 155—157, 165, 228
— cuneiforme I 155, 156, 166, 228, 234
— cuneiforme II 155—157, 167
— cuneiforme III 155—157, 168
— ethmoidale 68—72, 80, 93, 94, 97, 100, 101
— frontale 40, 41, 45—49, 68—71, 97—100, 103, 104
— hamatum 128—131, 205—207
— hyoideum 96, 259—261
— ilium 37, 134—138
— incisivum 108
— ischii 134—138
— lacrimale 40, 41
— lunatum 128—131, 205, 207
— multangulum majus 128—131, 205, 206
— — minus 128—131, 205, 206
— nasale 40, 41, 75, 88, 89, 97, 98, 103, 104
— naviculare manus 128—131, 205, 206
— — pedis 155—157, 164, 228
— occipitale 46, 50—53, 104, 185—189, 191
— palatinum 75, 81—83, 85—87, 98, 99, 101—105, 108
— parietale 40, 41, 46, 47, 99
— pisiforme 129—131, 207
— pubis 134—138
— sacrum 15—20, 23, 37, 38, 180
— sphenoidale 46, 54—56, 193
— temporale 40, 41, 44, 46, 57—65, 193
— triquetrum 128—131, 205, 206
— zygomaticum 97, 99—101, 194
ossa metacarpalia 128, 132, 205
— metatarsalia 155—157
— sesamoidea manus 207
— — pedis 155

P.

palatum durum 108, 271
pars alveolaris mandibulae 92
— basilaris ossis occipitalis 44, 46, 152, 186—188
— calcaneo—cuboidea ligamenti bifurcati 231
— — navicularis ligamenti bifurcati 231
pars conoidea ligamenti coracoclavicularis 196—199
— horizontalis ossis palatini 44, 83, 102, 103
— lateralis ossis occipitalis 44, 50-52, 106, 108, 186
— — — sacri 17
— mastoidea ossis temporalis 44, 46, 57, 59, 60, 106
— nasalis ossis frontalis 68
— orbitalis ossis frontalis 46, 68, 69
— perpendicularis ossis palatini 82, 85, 103
— petrosa ossis temporalis 44, 46, 58
— trapezoidea ligamenti coracoclavicularis 196, 199
— tympanica ossis temporalis 57
patella 144, 145, 220, 222, 225
pecten ossis pubis 134—136, 256
peritonaeum 256
pes anserinus 305, 306
phalanges digitorum manus 130—133
— — pedis 155—157
planum nuchale ossis occipitalis 44, 50, 52
— occipitale 50
— popliteum 139, 140, 309, 313
— sternale 33
— temporale 41
plexus brachialis 249, 261, 262, 273
plica alaris (articul. genu) 222, 225
— synovialis patellaris 222
porus acusticus externus 41, 44
— — internus 46, 58
processus accessorius (vertebrae lumbalis) 11, 13, 14
— alaris ossis ethmoidalis 46, 72, 74
— alveolaris maxillae 40, 79, 82, 98, 100
— articularis inferior (vertebrar.) 2, 7, 8, 10, 11, 13
— — superior (vertebrar.) 4, 181
— — — ossis sacri 15—17, 19
— clinoideus anterior 46, 56
— — medius 46
— — posterior 46, 56
— condyloideus mandibulae 41, 92—95, 192, 194
— coracoideus scapulae 36, 110—112, 196, 199, 200
— coronoideus mandibulae 41, 92, 93, 95, 192, 194
— — ulnae 120, 121
— ethmoidalis conchae nasalis inferioris 83, 84
— falciformis lig. sacrotuberosi 209, 210
— frontalis maxillae, 40, 41, 78, 79, 82, 97
— frontosphenoidalis ossis zygomatici 90, 91
— intrajugularis ossis occipitalis 52, 53, 60

processus intrajugularis ossis temporalis 60
— jugularis ossis occipitalis 46, 51—53
— lacrimalis conchae nasalis inferioris 83, 84
— lateralis tali 156, 158, 159
— — tuberis calcanei 155, 161
— mamillaris (vertebrae lumbalis) 11, 13, 14
— mastoideus 41, 44, 57, 60, 192
— maxillaris conchae nasalis inferioris 84
— — ossis palatini 86
— medialis tuberis calcanei 155, 160, 234
— orbitalis ossis palatini 85—87, 98
— palatinus maxillae 44, 75, 78, 102, 103
— posterior tali 158, 159
— pterygoideus (ossis sphenoidalis) 81, 98, 99, 102, 103, 108, 193
— pyramidalis ossis palatini 85, 87, 102, 105
— sphenoidalis ossis palatini 82, 85—87
— spinosus vertebrae 1, 2, 4, 8—14, 181
— styloideus ossis metacarp. III 128, 130
— — — radii 123, 125, 126, 129
— — — temporalis 44, 57, 58, 60, 63, 64
— — — ulnae 119—121, 127—129
— temporalis ossis zygomat. 90, 91
— transversus ossis coccygis 22
— — vertebrae 1, 2, 3a, 4, 9, 11—14, 181
— trochlearis calcanei 157, 161
— uncinatus ossis ethmoidalis 83, 104
— vaginalis ossis sphenoidalis 56
— xiphoideus sterni 33, 34
— zygomaticus maxillae 44, 79, 98, 102
— — ossis frontalis 40, 68—71
— — — temporalis 57, 59, 60, 194
prominentia canalis semicircularis lateralis 65
promontorium (columnae vertebralis) 25
— ossis temporalis 64, 65
protuberantia mentalis 97
— occipitalis externa 44, 50, 239
— — interna 46, 51
pyramis ossis temporalis 46, 49, 59, 106, 109

R.

radius 122—129, 201—203
radix arcus vertebrae 1, 12, 14
radices nervor. cervical 187
ramus inferior ossis ischii 136—138
— — — pubis 136—138
— mandibulae 40, 92, 93
— superior ossis ischii 136, 137
— — — pubis 136—138
raphe palpebralis lateralis 265, 266
rectum 256
regio abdominis lateralis 235, 236
— acromialis 235—237
— analis 230, 238a, 238b
— antibrachii dorsalis 236
— — radialis 235, 236
— — ulnaris 235, 236
— — volaris 235, 236
— auricularis 236, 237
— brachii anterior 235, 236
— — lateralis 235, 236
— — medialis 235, 236
— — posterior 235, 236
— buccalis 237
— calcanea 235, 236
— clavicularis 235, 237
— colli anterior 235, 237
— — lateralis 235, 237
— coxae 235, 236
— cruris anterior 235
— cruris lateralis 235, 236
— — medialis 235
— cubiti anterior 235
— lateralis 235, 236
— — medialis 235
— — posterior 236
— deltoidea 235—237
— (-nes) digitorum manus 235, 236
— — pedis 235, 236
— dorsalis digitorum 236
— — manus 235, 236
— — pedis 235, 236
— epigastrica 235
— femoris anterior 235
— — lateralis 235, 236
— — medialis 235, 236
— — posterior 236
— frontalis 235, 237
— genu anterior 235
— — posterior 236
— glutaea 236, 238a, 238b
— hyoidea 237
— hypochondriaca 235, 236
— hypogastrica 235
— infraclavicularis 235, 237
— inframammalis 235
— infraorbitalis 237
— inguinalis 235
— interscapularis 236
— labialis inferior 247
— — superior 237
— laryngea 237
— lumbalis 236

regio malleolaris lateralis 230
— — medialis 235
— mammalis 235
— mastoidea 225, 237
— mediana dorsi 236
— mentalis 235, 237
— mesogastrica 235
— nasalis 235, 237
— nuchae 236, 237
— occipitalis 236, 237
— olecrani 235, 236
— oralis 235, 237
— orbitalis 235, 237
— palpebralis inferior 237
— — superior 237
— parietalis 235—237
— parotideomasseterica 237
— patellaris 235
— pectoralis lateralis 235, 236
— perinealis 238a, 238b
— plantaris 236
— pubica 235
— pudendalis 238a, 238b
— retromalleolaris lateralis 236
— sacralis 236, 238a, 238b
— scapularis 236
— sternalis 235, 237
— sternocleidomastoidea 235, 237
— subhyoidea 237
— subinguinalis 235
— submaxillaris 237
— submentalis 237
— supraorbitalis 237
— suprascapularis 236
— suprasternalis 237
— suralis 235, 236
— thyreoidea 237
— trochanterica 235, 236
— umbilicalis 235
— (-nes) unguiculares digitorum manus 235, 236
— — — pedis 235
— urogenitalis 238a, 238b
— (-nes) volares digitorum 235, 236
— — manus 235, 236
— zygomatica 237
retinaculum patellae laterale 220
— — mediale 220
— peronaeorum inferius 316, 317, 323
— — superius 312—314; 316

S.

scapula 35—38, 110—112
septum choanarum 77
— intermusculare laterale brachii 274, 275 282—284, Tab. 2, Fig. 2
— — mediale brachii 276—281, Tab. 2, Fig. 1
— — — femoris 221
— nasi osseum 40
sinus frontalis 75, 104
— maxillaris 78, 81, 93, 99, 100, 104
— sphenoidalis 75, 99, 103, 104
— tarsi 157
solum tympani 58a, 50b
spina angularis ossis sphenoidalis 55, 56, 105
— ethmoidalis 46, 53
— frontalis (ossis frontalis) 68—70
— iliaca anterior inferior 134—136
— — — superior 134—136, 211
— — posterior inferior 134, 135
— — posterior superior 134, 135, 210
spina ischiadica 38, 134, 135, 137
— mentalis 94, 95
— m. recti lateralis 99
— nasalis anterior 40, 41, 78, 79, 103, 104
— — posterior 44, 75, 81, 82, 85, 202, 104
— (-ae) palatina (-ae) 102
— scapulae 110, 197, 198, 239
— supra meatum 57
— trochlearis 70
spongiosa ossium 169—173
squama frontalis 41, 46, 68, 69, 75, 99
— occipitalis 41, 44, 50—52, 107, 108, 187
— temporalis 41, 46, 49, 57, 59, 99, 108
sulcus arteriae occipitalis 60
— — temporalis mediae 57
— — vertebralis (atlantis) 5, 185
— (-i) arteriosus (-i) meningeus (-i) 46, 48, 57, 58, 67
— calcanei 161, 162
— canaliculi mastoidei 60
— caroticus (ossis sphenoidalis) 46, 56
— carpi 192
— chiasmatis (ossis sphenoidalis) 46, 53
— costae 29, 30
— ethmoidalis ossis nasalis 89
— glutaeus 299, Tab. 3, Fig. 2
— infraorbitalis 79, 97, 98, 101
— intertubercularis 116, 117
— lacrimalis maxillae 89
— — ossis lacrimalis 80
— malleolaris medialis 147

sulcus musculi flexoris hallucis longi calcanei 160, 234
— — peronaei longi ossis cuboidei 155, 233, 234
— musculorum peronaeorum fibulae 159, 151
— mylohyoideus 94, 95, 193
— nervi petrosi superficialis majoris 46, 59
— — — — minoris 46, 59
— — radialis humeri 115
— — spinalis (vertebrae cervicalis) 4
— — ulnaris humeri 115, 118
— obturatorius 135
— (-i) palatinus (-i) 102
— paraglenoidalis (ossis ilium) 135
— petrosus inferior 46, 53, 58
— — superior 46, 58
— plantaris lateralis 319
— — medialis 319
— pterygopalatinus maxillae 78
— — ossis palatini 85, 86
— — — sphenoidalis 55
— sagittalis 46, 48, 51, 67, 69
— sigmoideus 46, 53, 67, 188
sulcus subclaviae 26
— tali 158, 159
— transversus 46, 51, 53
— tubae auditivae 56
sustentaculum tali 155, 160, 162, 230, 235
sutura coronalis 40, 41, 47, 48, 107
— frontalis 107
— frontoethmoidalis 46
— frontolacrimalis 40
— frontomaxillaris 40, 97
— incisiva 102
— infraorbitalis 97
— intermaxillaris 40
— internasalis 40
— lacrimo maxillaris 41
— lacrimoethmoidalis 98
— lambdoidea 41, 44, 46—48
— mendosa 106, 108
— nasofrontalis 40, 75
— nasomaxillaris 40, 41
— occipitomastoidea 41, 44, 46
— palatina mediana 44, 102
— — transversa 44, 81, 102
— parietomastoidea 41, 44, 46
— sagittalis 48, 107
— sphenofrontalis 40, 41, 46, 99
— sphenooccipitalis 46
— sphenoparietalis 40, 41, 44, 46
— sphenosquamosa 44, 46
sutura sphenozygomatica 40, 41
— squamosa 41, 46
— squamosomastoidea 61, 62
— zygomaticofrontalis 40, 41
— zygomaticomaxillaris 40, 44, 97, 100, 101
— zygomaticotemporalis 41, 44
symphysis ossium pubis 38, 209—214
synchondroses sacrales 19
synchondrosis sphenooccipitalis 46, 53, 56
— sternalis 184, 195
syndesmosis tibiofibularis 226

T.

talus 157—159, 227—229
tarsus 155—157
tegmen tympani 58 a, 58 b, 59
tendo calcaneus Tab. 4, Fig. 1, 311—314, 316 227, 208, 230, 233, 324
— musculi abductor. dig. V pedis 322
— — — hallucis 322
— — — pollicis longi 278, 288—290
— — bicipitis brachii 276—281
tendo musculi bicipitis brachii capitis longi 276, 277
— — — femoris 315
— — brachialis 279—281
— — brachioradialis 278—280, 288, 289
— — extensoris carpi radialis brevis 282—285, 287
— — — — — longi 282—285, 287
— — — — ulnaris 282—285, 287
— — — digitorum (pedis) brevis 318
— — — — (manus) communis 284, 287, 296
— — — — (pedis) longi 315—318, 323
— — — digiti V-proprius 287
— — — hallucis longi 315, 317, 323, 324
— — — pollicis brevis 287
— — — — longi 283—285, 287
— — flexoris carpi radialis 278—281, 288, 289
— — — — ulnaris 278—281, 288, 289
— — — digitorum (manus) profundus 281, 289—291
— — — — — sublimis 280, 281, 288—291
— — — — (pedis) brevis 321, 322
— — — — — longus 313, 314, 321, 322
— — — hallucis longi 313, 320—322, 324
— gastrocnemii (caput laterale) 311, 312
— — — — (mediale) 311, 312
— — gracilis 306
— (ines) — (orum) interosseorum volarium 297

tendo musculi bicipitis dorsalium (manus) 294
— — latissimi dorsi 276, 277
— (ines) — (orum) lumbricalium manus 294, 297
— — — — — pedis 322
— — obturatorius interni 308
— — palmaris longi 278—281, 286
— — pectoralis majoris 273, 276
— — peronaei brevis 228, 231—223, 315—318, 313
— — — longi 233, 316, 321—323
— — — tertii 316—318, 323
— — plantaris 312
— — pollicis longi 281
— — quadricipitis femoris 220, 222, 316
— — recti femoris 303—305
— — semimembranosi 307—309, 311
— — semitendinosi 307—309, 311
— — tibialis anterioris 230, 315, 317, 318
— — — posterioris 230, 233, 312—314, 322, 324
— — tricipitis brachii 274, 275
thenar 286
thorax 35—38
tibia 146—149, 151—154, 221, 226, 227, 229—231
tractus iliotibialis fasciae latae 299, 310, Tab. 3, Fig. 1 und 2
trigonum deltoideopectorale 235, 237, 248
— lumbale 239, 240, 299
trigonum omoclaviculare 227
trochanter major 139—142, 209—211, 215, 216
— minor 139—142, 215, 216, 219
trochlea humeri 115, 116, 118, 204
— phalang. digitorum 132
— tali 156, 159, 231
tuber calcanei 155, 160, 161, 234
— frontale 68, 106
— ischiadicum 37, 134—136, 138, 210
— maxillare 78
— parietale 106—108
tuberculum anterius atlantis 5, 6
— — processus transversi 4
— articulare ossis temporalis 66, 194
— costae 26—30, 177
— intercondyloideum laterale tibiae 153
— — mediale tibiae 153
— jugulare 46—51, 53
— laterale processus post. tali 159
— majus (humeri) 115—117
— mentale 92
— minus humeri 116, 117
tuberculum obturatorium anterius 135
— — posterius 135, 136
— ossis multanguli majoris 129, 131
— — navicularis (manus) 129
— pharyngeum 52
— posterius processus transversi 4
— pubicum 134, 136, 213, 214
— scaleni (costae I) 36
— sellae turcicae 46, 53
tuberositas coracoidea claviculae 113, 114
— costae II 27
— costalis claviculae 113
— deltoidea (humeri) 116
— glutaea 142, 216
— iliaca 135
— infraglenoidalis scapulae 110, 112
— masseterica mandibulae 92, 93
— ossis cuboidei 155
— — metatarsalis hallucis 152
— — metatarsalis V 155, 156, 234
— — navicularis pedis 155, 156, 163, 164, 234
— pterygoidea mandibulae 94
— radii 123, 124, 126
— sacralis 15
— supraglenoidalis scapulae 112
— tibiae 146, 152, 220, 226
— ulnae 119, 221
— unguicularis digitorum 130

U.

ulna 119—121, 126—129, 132, 133, 201—207
umbilicus 248

V.

vagina mucosa intertubercularis 196, 200, 277
— — tendinum digitalium (manus) 295
— — — m. abductoris pollicis longi 296
— — — m. extensoris digitorum et m. extensoris indicis 296
— — — — — digit. pedis et m. peronaei III 323
— — — — — hallucis longi 319, 320, 324
— — — — — pollicis brevis 296
— — — — — — longi 296
— — — — carpi radialis 296
— — — — — ulnaris 296
— — — — flexoris carpi radialis 295
— — tendinis m. flexoris digitorum (manus) sublimis et profundi 295
— — — — — digitorum (pedis) longi 324
— — — — — hallucis longi 323

vagina mucosa tendinis m. flexoris peronaei brevis 323
— — — — — longi 323
— — — — — pollicis longi 295
— — — — tibialis anterioris 324
— — — — — posterioris 324
— m. recti abdominis 248, 252—254
— processus styloidei (ossis temporalis) 57, 60
vasa axillaria 249
— brachialia 273
— femoralia Tab. 256, 301, 302, 304
— poplitea 312
vena cephalica 248, Tab. 2, Fig. 1
— femoralis Tab. 3, Fig. 1
— jugularis interna 261
vena mediana cubiti 204
— saphena magna 301, Tab. 3, Fig. 1
vertebrae cervicales 3—9, 23, 35—38
— coccygeae 20—22
— lumbales 11, 14, 23, 35—38
— thoracales 1, 2, 10—13, 35—38
vertebra prominens 239
vesica urinaria 256
vestibulum (ossis temporalis) 63, 64
vincula tendinea (tendinum digitorum manus) 290, 291
vomer 49, 75—77, 100

Z.

zona orbicularis (articulationis coxae) 218

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